ANNUAL REPORT

Provincial Board of Health

1913

Thirty-Second Annual Report

OF THE

Provincial Board of Health

OF

Ontario, Canada

FOR THE YEAR

1913

PRINTED BY ORDER OF

THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
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1914

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To His Honour Sir John Morison Gibson, K.C., LL.D., K.C.B.,

Lieutenant-Governor of the Province of Ontario.

May it Please Your Honour,—I herewith beg to present for your consideration the thirty-second Annual Report of the Provincial Board of Health for the year 1913.

Respectfully submitted,

W. J. Hanna,
Provincial Secretary.

To THE HONOURABLE W. J. HANNA, K.C., M.P.P.,

Provincial Secretary of Ontario.

SIR,—I have the honour to submit for your approval the Thirty-second Annual Report of the Provincial Board of Health, made in conformity with and under the provisions of the Public Health Act, for the year 1913.

I have the honour to be, Sir,

Your obedient servant,

JOHN W. S. MCCULLOUGH,

Chief Officer of Health.

PROVINCIAL BOARD OF HEALTH OF ONTARIO

1913

Adam H. Wright, M.D., *Chairman* .... Toronto
Henry R. Casgrain, M.D. .... Windsor
Thomas E. Kaiser, M.D. .... Oshawa
William H. Howey, M.D. .... Sudbury
A. A. Weagant, M.D. .... Ottawa
James Roberts, M.D., M.O.H. .... Hamilton

Secretary and Chief Officer of Health,

John W. S. McCullough, M. D., D.P.H. (Tor.)

Provincial Inspector,

R. W. Bell, M.D.

Provincial Bacteriologist.

J. A. Amyot, M.D.

Assistant Bacteriologist,

Frank W. Schofield, D.V.S.

Branch Laboratory—Kingston,

W. T. Connell, M.D.

Provincial Chemist,

H. M. Lancaster, B.A.Sc.

Assistant Chemist,

W. J. Fawcett, M.A.

Provincial Sanitary Engineer,

F. A. Dallyn, B.A.Sc., C.E. (Tor.).

District Officers of Health,

District.
No. 1.—David B. Bentley, M.D., Sarnia.
No. 2.—Thomas J. McNally, M.D., Guelph.
No. 3.—Daniel A. McClenahan, M.D., Hamilton.
No. 4.—George Clinton, M.D., Belleville.
No. 5.—Paul J. Moloney, M.D., Cornwall.
No. 6.—W. Egerton George, M.D., North Bay.
No. 7.—Robert E. Wodehouse, M.D., Fort William.

Sanitary Inspector,

George E. Young.

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BY THE CHIEF OFFICER

This is the Thirty-second Annual Report of the Provincial Board of Health of Ontario for the year ending December 31st., 1913.

The Board held four regular meetings during the year.

The appointment by the Legislature of a Provincial Sanitary Engineer has relieved the Board and its executive of a large responsibility in the scrutiny and approval of plans and specifications of water works and sewerage systems. This appointment with its resulting organization will be of the greatest value in the future to municipalities undertaking work of this character. A list of the plans and specifications relating to water and sewage approved during the year will be found elsewhere in this volume. (See page 45.)

The Legislature in the session of 1913 amended the Public Health Act as follows:—

When local board may instal sanitary conveniences.

(2) Where a local board in any city recommends that sanitary conveniences should be installed in any building and is of the opinion that the owner of the premises is unable to pay the expense of the same at once, the municipality may install suitable sanitary conveniences at the expense of the owner and the board may direct that the cost, including interest at five per cent. on the deferred payments, be paid by the owner in equal successive annual payments extending over a period not exceeding five years and that such annual payments be added by the clerk of the municipality to the collectors' roll and collected in like manner as municipal taxes.

Payment by owner in equal annual instalments.

2. Subsection 2 of section 86 of *The Public Health Act* is amended by inserting after the word "air" in the fourth line the word "space."

2 Geo. V. c. 58, s. 86, subsec. 2, amended.

3. Subsection 1 of section 96 of *The Public Health Act* is repealed and the following substituted therefor:

2 Geo. V. c. 58, s. 96, (1), repealed.

96.—(1) Where the Provincial Board reports in writing that it is of opinion that it is necessary in the interest of the public health that a waterworks system or an adequate water purification plant, or a sewer or a sewerage system, or an adequate sewage treatment plant, should be established or continued, or that any existing waterworks system, water purification plant, sewer or sewerage system, or sewage treatment plant, should be improved, extended, enlarged, altered, renewed or replaced, it shall not be necessary to obtain the assent of the electors to any by-law for incurring a debt for any of such purposes.

Assent of electors not required.

Council on report of Provincial Board to pass by-laws and carry out works.

(1*a*). Where the Provincial Board has reported as provided by subsection 1, the council of a municipality shall forthwith pass all necessary by-laws for the establishment of the works reported upon and the corporation of the municipality shall immediately commence the work and carry the same to completion without unnecessary delay.

2 Geo. V. c. 58, s. 97, repealed.

4. Section 97 of *The Public Health Act* is repealed and the following substituted therefor:

Repairs and renewals, etc., powers of Provincial Board.

97. Every waterworks system, water purification plant, sewer or sewerage system and sewage treatment plant, established for public use shall at all times be maintained and kept in repair as may be necessary for the protection of the public health and as may be directed by any special order of the Provincial Board or by the Regulations.

Penalty.

98. Any municipal corporation or body or person refusing or neglecting to carry out the provisions of either of the two next preceding sections after notice from the Provincial Board so to do, shall incur a penalty of $100 for every day upon which such default continues.

Act to be retroactive.

5. *The Public Health Act* shall be read as if the sections amended by sections 2 to 4 had been enacted as so amended on the 16th day of April, 1912.

The Cemetery Act, Chap. 56, 1913, passed at the same session, gives to the Board important powers in reference to the establishment of cemeteries and the making of Regulations for their control.

The following Regulation for the Control of Communicable Diseases was passed by an Order-in-Council on the 3rd day of April, A.D. 1913:

Regulation 2 (a) When any of the communicable diseases named in Regulation 1 exists in any municipality the Provincial Board of Health may, with the consent of the Minister, prevent any person or persons from passing to or from such municipality, and may for this purpose prevent the transportation of any person or persons to or from the municipality by means of any boat, vessel, steam, electric or other car, carriage, vehicle or premises. It shall be the duty of the Local Board of Health, the corporation of the municipality and of every officer thereof to assist in every possible way in carrying out the provisions of this and every Regulation of the Board.

The effect of this Regulation is that a municipality which is not taking proper steps to control any communicable disease such as smallpox, within its limits, may be placed under quarantine.

Early in the year there was a sharp outbreak of smallpox in Niagara Falls. The Provincial Inspector, Dr. Bell, and the District Officer, Dr. McClenahan, lent their efforts to those of the Local Board for its control, but the majority of the City Council gave very poor support to the Medical Officer of Health, Dr. Wilson, who resigned in consequence and was succeeded by Dr. Logan. The City Council about this time was requested by the Board to issue a proclamation for

general vaccination, and on their refusal to do so the Board issued an order on the Council requiring that body to at once make the proclamation under penalty of a quarantine of the city. This had the desired effect. The proclamation was forthwith issued and the outbreak was soon under control. There were in all some 45 cases. The matter is fully dealt with in Dr. McClenahan's report included with that of the other District Officers. (Appdx. B, page 281.) A noticeable feature of this epidemic was the evidence of the protection afforded by vaccination.

During the summer of 1913 the writer in company with Dr. Chas. A. Hodgetts of the Dominion Conservation Commission spent two months on a visit to a large number of the sewage disposal plants of Great Britain and the Continent. In addition, the water supplies of a number of cities including Manchester, Glasgow, London and Paris, and the large Fever Hospitals of Liverpool and Edinburgh were inspected. A large amount of valuable information was secured and tabulated. It is kept on file by the Board for future reference.

The public health exhibit with the Board's moving picture show, illustrating public health topics, continued its round of the province during the year, the work of lecturing in the different centres being undertaken by the respective District Officer. The usual exhibit was given at the Canadian National Exhibition and for the third time a Gold Medal was awarded to the Board.

It is gratifying to know the increasing interest taken by the public in this travelling exhibit. At almost every point where it has been shown there is a large attendance of both adults and children. Its value as a means of education, particularly to the children, seems to be much appreciated. In the present year (1914) the Board was asked to send the exhibit to the International Tuberculosis Congress at Lyons, France. Want of funds prevented the acceptance of this invitation.

The first report of the work of the District Officers of Health, appointed last year, has just been issued, and for convenience is included in this volume. It contains a list of the Medical Officers of Health in the various municipalities of the province now published for the first time.

The Annual Conference of Health Officers was held in May. There was an attendance of some 300. The programme was an extensive one, the papers of good character and full and free discussions were maintained. The general opinion of those in attendance was that the meetings would be productive of great value to them. The attendance should, however, be twice as large. Next year it is the intention of the Board to enforce the statute requiring all medical officers to attend this conference.

The notification of communicable diseases, especially of tuberculosis, while much improved in recent years, is as yet unsatisfactory. Medical men claim, and not unreasonably, in my opinion, that they should receive compensation for work of this character. In England, for example, a fee is paid for each such notification.

There is considerable demand by the members of the medical profession and by those engaged in sanitary work for the creation of a federal department of public health. Resolutions have repeatedly been passed by various medical and public health associations in favour of such a department. There is plenty of work for such a department. It is favoured by the present able Director-General of the Public Health of Canada. In our opinion there is every reason for the establishment of such a department. Its service to the whole Dominion would be of the greatest value.

The Canadian Public Health Association held its Third Annual Congress at Regina, Sask. The writer had the honour of presiding at this Congress. The meetings were well attended, and created a great deal of interest all over our Western Provinces. The hospitality of the City of Regina, of the Government and of the citizens of Saskatchewan was freely extended. The press gave very full accounts of the proceedings. As an educational factor at least this Association seems to be a success.

In April the Board commenced an extensive examination of the International Boundary Waters for the International Joint Commission, with a view of determining "*to what extent and by what causes and in what localities have the boundary waters between the United States and Canada been polluted so as to be injurious to public health and unfit for domestic and other uses.*" For this work the Board placed in the field seven officers under the supervision of Dr. Amyot, Director of the Board's Laboratories, and Mr. F. A. Dallyn, the Provincial Sanitary Engineer.

Two laboratories were fully equipped at the expense of the Commission and operated by our own staff at—

Fort Frances during the period from July 8th to July 22nd.
Port Arthur during the period from July 28th to August 19th.
Sault Ste. Marie, Ont., during the period from June 28th to July 17th.
Sarnia, during the period from July 29th to August 25th.
Windsor, during the period from September 4th to October 2nd.
Amherstburg, during the period from September 6th to October 14th.
Port Stanley during the period from October 6th to October 14th.
Fort Erie during the period from May 26th to June 18th.
Niagara-on-the-Lake during the period from May 28th to June 18th.
Kingston, during the period from April 9th to May 17th.

The United States authorities simultaneously conducted sampling operations and established laboratories at Port Huron, Mich., Detroit, Mich., Buffalo, N.Y., Youngstown, N.Y., Clayton, N.Y., and Van Buren, Me. Some work was also done under the supervision of the Quebec Board of Health on the St. Lawrence River, a laboratory being established at Montreal.

Some fifteen thousand (15,000) analyses were made in the laboratories of the Provincial Board of Health alone during the period of examination, the results of which appear in a large volume published by the International Joint Commission under date of January 16th, 1914*. During this investigation we availed ourselves of the opportunity to study the municipal water supply situation, especially at Kingston, Windsor, Amherstburg, Sault Ste. Marie, and Port Arthur, Ont. Some careful work was done in checking up the efficiency of the use of bleaching powder as a disinfectant of water at Port Arthur, Sarnia, Windsor, Amherstburg, Kingston, and Niagara-on-the-Lake. By using the information obtained, considerable improvement was secured in the operation of these several plants.

The results of the investigation in chief show that the international boundary waters between the United States and Ontario have already reached a considerable degree of sewage pollution and that in the opinion of those engaged in the work practically none of these waters may be safely used without purification as a municipal water supply. The work showed that this pollution arose almost

*This volume may be obtained from Mr. L. J. Burpee, Secretary of the International Joint commission, Ottawa, Ontario.

entirely from the unrestrained discharge of sewage both from the municipalities located along these waterways and from the vessels plying upon them. The part that navigation plays in this pollution had not been fully recognized before this work was undertaken. This has now been thoroughly established, and there is no question but that measures should generally be taken to restrict the indiscriminate discharge of sewage from boats, in addition to the enacting of legislation controlling the sewage of municipalities.

In their report the Commission have acknowledged their obligation to the Province of Ontario for the assistance rendered in their work. The fact that we were of such material assistance is a great compliment to our organization and to the personnel of our assistants: Messrs. C. R. Avery, B.A.Sc., Dr. C. P. Brown, Dr. R. D. Defries, B.A., A. V. DeLaporte, B.A.Sc., Dr. W. R. Jaffrey, N. F. Parkinson, B.A.Sc., and C. S. Robertson, B.A.Sc.

It is a further source of gratification that our Board was not only entrusted with a large portion of this work, but also with the funds for its successful accomplishment, and that the Commission has expressed its entire satisfaction with the result of our efforts.

The following portion of the report of the Sanitary Experts, upon the Pollution of Boundary Waters, having reference to the Province of Ontario, is taken from the International Joint Commission Report as being of particular interest to the citizens of this province and included herewith, page 7:

The following table shows the deaths from tuberculosis for the last 10 years by ages, and cases and deaths from communicable diseases reported weekly by the local Boards of Health for the year 1913:

DEATHS IN ONTARIO FROM TUBERCULOSIS BY AGES, 1904-1913.

Year.	Total.	Under 5 years.					5-9	10-14	15-19	20-29	30-39	40-49	50-59	60-69	70-79	80 and over.	Not stated.	Total deaths from all causes.
		0-1	1	2	3	4												
	25,064	653	424	225	130	149	440	622	2,086	7,092	5,083	3,233	2,207	1,566	725	133	296	313,791
1904...	2,877	7	52	26	9	17	52	78	278	826	587	374	257	175	104	13	22	29,600
1905...	2,667	...	55	31	21	18	47	85	266	813	509	341	212	144	79	16	30	29,748
1906...	2,911	251	72	23	14	14	38	74	234	724	604	367	228	169	66	19	14	31,244
1907...	2,530	74	41	27	20	15	44	62	206	745	499	311	227	173	64	9	13	31,756
1908...	2,511	68	46	20	13	13	43	67	216	764	479	315	217	136	70	14	30	30,947
1909...	2,380	47	27	25	9	15	54	54	179	687	487	290	222	163	66	15	40	30,792
1910...	2,291	38	35	19	15	6	36	55	184	652	463	293	222	160	71	18	24	31,332
1911...	2,353	63	30	15	10	18	48	64	181	618	476	325	218	156	85	12	34	31,878
1912...	2,250	50	30	19	9	15	46	42	154	631	500	304	200	134	64	7	42	32,150
1913...	2,294	53	36	20	10	18	32	41	188	632	479	313	204	156	56	10	47	34,317

CASES AND DEATHS FROM COMMUNICABLE DISEASES REPORTED WEEKLY BY LOCAL BOARDS OF HEALTH FOR THE YEAR 1913.

Month.	Smallpox.		Scarlet Fever		Diphtheria.		Measles.		Whooping Cough.		Typhoid.		Tuberculosis		Infantile Paralysis.		Cerebro-spinal Meningitis.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
January	55	......	359	14	265	28	705	42	45	4	101	35	165	101	8	7	6	6
February	145	......	311	11	169	26	1,210	13	75	11	47	11	158	95	2	2	4	4
March	92	......	237	4	144	18	1,444	16	48	6	33	5	163	106	......	......	2	2
April	120	1	279	14	164	19	1,422	10	23	3	69	14	149	105	2	1	8	6
May	80	......	288	9	136	23	1,398	18	68	14	86	14	186	155	......	......	7	6
June	62	......	212	8	139	16	904	10	57	9	41	6	143	99	4	2	4	4
July	74	1	135	4	113	8	295	11	22	6	72	9	108	74	6	4	6	6
August	25	......	102	6	86	14	82	3	30	9	259	21	107	71	......	......	9	6
September	3	......	95	8	112	12	29	1	38	8	338	27	98	72	5	3	5	3
October	27	......	189	6	255	30	83	2	41	6	294	33	106	62	5	......	6	4
November	54	......	298	8	319	22	175	5	6	8	120	28	90	48	1	......	3	......
December	37	......	241	9	292	17	148	3	31	......	59	10	103	52	2	1	1	1
	774	2	2,746	101	2,194	233	7,895	134	484	84	1,519	213	1,576	*1,040	35	20	61	48

* Only 40 per cent. of the deaths from tuberculosis are reported by the Local Boards of Health.

REPORT OF THE SANITARY EXPERTS

TO THE INTERNATIONAL JOINT COMMISSION UPON THE POLLUTION OF THE BOUNDARY WATERS BETWEEN CANADA AND THE UNITED STATES

INTRODUCTION

In this report data are presented indicating the source, extent and degree of pollution of these waters in such a manner as will enable the Commission to answer the first of the two following questions propounded by the Governments of the United States and Canada:

1. To what extent and by what causes and in what localities have the boundary waters between the United States and Canada been polluted so as to be injurious to the public health and unfit for domestic or other uses?

2. In what way or manner, whether by the construction and operation of suitable drainage canals or plants at convenient points or otherwise, is it possible and advisable to remedy or prevent the pollution of these waters, and by what means or arrangement can the proper construction or operation of remedial or preventative works, or a system or method of rendering these waters sanitary and suitable for domestic or other uses, be best secured and maintained in order to ensure the adequate protection and development of all interests involved on both sides of the boundary and to fulfil the obligations undertaken in Article IV. of the waterways treaty of January 11, 1909, between the United States and Great Britain, in which it is agreed that the waters therein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other.

Very valuable assistance was rendered to the Commission by the United States Public Health Service and the Provincial Board of Health of Ontario, Canada. The Provincial Board of Health of Quebec, the State Board of Health of Michigan and the Department of Health of the State of New York are also entitled to the thanks of the Commission for assistance in carrying on investigations on the St. Clair River, Niagara River and St. Lawrence River. The co-operation of these organizations made it possible to bring the work to an early completion.

The courtesy of the various municipal authorities, the United States War Department Corps of Engineers, the Weather Bureaus of the United States and Canada, and the Bureaus of the Census in both countries, is gratefully acknowledged.

We are also indebted to the Honorable the Secretary of the Treasury for furnishing the U.S. Revenue Cutter *Morrill* for the purpose of taking samples in Lake Erie, and to the officers of the *Morrill* for their courtesy and assistance to our bacteriologists and sample collectors.

The preparation of charts, sketches and diagrams was entrusted to the Provincial Board of Health of Ontario, under the supervision of Mr. F. A. Dallyn, C.E. (Tor.), the Board's sanitary engineer.

Scope of the Field Investigations.

The field investigation covered the examination of the waters of Rainy River, parts of Rainy Lake and Lake of the Woods, that part of Lake Superior known as Thunder Bay, the St. Mary's River from the headwaters in Lake Superior to Mud Lake (including a set of samples through Detour Passage to Mackinac Island), Lower Lake Huron, the St. Clair River, Lake St. Clair, the Detroit River, the western end of Lake Erie, the central portions of Lake Erie, (Port Stanley), the eastern end of Lake Erie, the Niagara River, the western portion of Lake Ontario, the eastern end of Lake Ontario, the St. Lawrence River to Cornwall, and that portion of the St. John River in which is the international boundary between the United States and Canada.

The area, population, source of water supply and quantity of water pumped for consumption, together with the probable quantity of sewage discharged, for each municipality in the areas under investigation, are included in the report.

The number of deaths from typhoid fever and the computation of the death rate per 100,000 for the greater number of municipalities on both sides of the border using these waters have been compiled and are included herein.

Meteorological data relative to the several points of investigation for the periods of examination were obtained from the Meteorological departments of the United States and Canada and are included in the appendix.

The number of sampling points was 1,447 and the total number of samples collected at these points was 17,784. Many other samples were taken to show the relation between local situations and municipal water supplies. In addition, samples were collected with a view to ascertaining the character and amount of pollution due to boat traffic. Some float and temperature experiments were made in conjunction with the bacteriological investigation.

SCHEDULE OF WORK PERFORMED.

Date 1913	Laboratory.	Waterway.	Headquarters.	No. of sample points.	Total number samples
July 8-22	Provincial Board of Health, Ontario	Rainy River.	Fort Frances, Ont.	192	955
July 28. Aug. 15.	" "	Lake Superior (Thunder Bay).	Port Arthur, Ont.	66	922
June 28- July 16.	" "	Lake Superior, St. Marys River.	Sault Ste. Marie, Mich.	104	1,065
July 29. Aug. 25.	" "	Lake Huron, St. Clair River.	Sarnia, Ont.	142	1,606
Sept.- Oct. 10.	" "	Lake St. Clair, Detroit River.	Windsor, Ont.	174	1,755
Sept.- Oct. 3.	" "	Detroit River, Lake Erie.	Amherstburg, Ont.	114	1,306
October.	" "	Lake Erie, Port Stanley.	Windsor, Ont.	51	214
May 26- June 17.	" "	Lake Erie, Niagara River.	Fort Erie, Ont.	133	1,375
May 27- June 12.	" "	Niagara River.	Niagara-on-the-Lake, Ont.	59	840
April 10- May 23-	" "	Lake Ontario, St. Lawrence River.	Kingston, Ont.	113	928
May 23- Aug. 27.	United States Public Health Service.	St. Clair River, Lake St. Clair, Detroit River, Lake Erie	Detroit, Mich.	70	1,812
June 12. July 23.	" "	Lake Erie.	U.S. Revenue Cutter "Morrill"	20	480
May 12- July 29-	" "	Lake Erie, Niagara River.	Buffalo, N.Y.	60	1,624
Aug.	" "	Lake Ontario. St. Lawrence River.	Clayton, N.Y.	32	482
Oct	" "	St. John River.	Van Buren, Me.	32	672
July 3- Aug. 13.	Michigan State Board of Health.	Lake Huron, St. Clair River.	Port Huron, Mich.	45	720
Aug. 1- Aug. 21.	New York State Department of Health	Niagara River, Lake Ontario.	Youngstown, N.Y.	42	338
Aug.	Provincial Board of Health, Quebec.	St. Lawrence River.	Montreal, Quebec.	8	480

SCOPE OF BACTERIOLOGIC EXAMINATION.

The examination of these waters was essentially a bacteriological one—the determination of the total bacteria count on nutrient agar (+10) at 18°-22° C. (48 hours), the count at 37° C. (24 hours), and the quantitative estimation of B. Coli as indicated by fermentation in lactose bile at 37° C. (48 hours).

Presentation of Data.

The presentation of the data obtained during this investigation involved the preparation of maps showing the location of the various sampling points, the detailed tabulation showing for each sampling point the average bacterial count per cubic centimetre on agar, B. Coli per 100 c.c. by Phelps' method,* the number of samples collected, dates of collection, maximums obtained during the period of examination at each point, and some illustrations showing graphically the source, degree and extent of tht pollution as indicated by the bacterial findings.

Indices of Pollution.

Since B. Coli is absent from unpolluted water, the estimation of this organism is therefore the most specific and best index available for showing the existence and degree of sewage pollution. The bacterial count at 37° C. on agar is nearly specific for intestinal organisms whose optimum growing temperature is that of the human body. The bacterial count at 18°-22° C. is less specific in an investigation to determine sewage pollution, but is valuable, nevertheless, the value being that it indicates the bacterial food value and quantity of the organic matter in a water. It does not indicate the character of the organic matter or whether the organic matter is faeces or decaying vegetable matter.

Purity of Great Lakes Water.

In certain localities on the Great Lakes and in all their connecting waterways dangerous sewage pollution was shown to exist, but the great bulk of the Great Lakes water remains in its pristine purity.

Our investigation shows that the colon bacillus is practically never normally present in unpolluted waters, and that the normal total bacterial count on nutrient agar (+10) of the Great Lakes waters is below 10 per c.c. This is clearly shown by the results of examination of samples collected in Thunder Bay, in Whitefish Bay, in Lake Huron, in Lake St. Clair, in Lake Erie at Abino Point section, and in cross-sections of Lake Ontario at both ends.

Classification of Great Lakes Water.

SUMMARY.

Class.	Number of B. Coli per 100 c.c.	Total Bacteria per c.c. agar (+10) 37° C.
1	Less than 2	Less than 10
2	2 to 10	10 to 25
3	10 to 20	25 to 50
4	20 to 50	50 to 100
5	Over 50	Over 100

Note.—The total bacterial count on agar at 37° C. is included in the above table because of its rather definite relation to B. Coli.

Class 1 represents those relatively pure waters found outside the zones of pollution. It is doubtful if any purer surface water than this can be found daily for long periods in inhabited areas.

Class 2 represents a slight pollution of a relatively pure water. The character, origin and intermittency of this pollution would determine its measure of safety as a drinking water. At times, such a water is undoubtedly unsafe without purification.

Class 3 represents considerable pollution. A water belonging to this class requires unremitting care in its purification.

Class 4 shows serious pollution. This water, in our opinion, could not be classed as a good raw water. It would impose a much more serious responsibility on a purification plant than Classes 2 or 3. In the Great Lakes Basin such a water should not

* Phelps, Earle B.: A method for calculating the number of B. Coli from the results of dilution tests. Reports and papers of the American Public Health Association, Vol. 33 1907, pt. 2, pp. 9-13. Note: This method considerably under-estimates the number of B. Co' but was most convenient for the purposes of this report.

be selected as a raw water for a purification plant; or, if the intake must be placed in such water, sources of pollution should be eliminated or nullifield by sewage treatment in order to place such a water in Classes 2 or 3.

Class 5. This is gross pollution. It reaches in extent from 50 to 34,000 B. Coli per 100 c.c. Even in the lesser numbers, such pollution with its fluctuations imposes an unreasonable burden upon a purification plant. Considering the source of its pollution —faeces—such a water should not be considered for public use.

In considering this classification, it is to be remembered that it is *arbitrary*. The classification arises out of the data contained in this report. The difference in the bacterial flora of these lake waters and that of comparatively warm river waters, subject to agricultural and municipal drainage, is very great, especally when measured by bacterial counts on agar and B. Coli, which represent almost invariably for these lake waters recently added sewage organisms.

In many instances Class No. 1 can be observed changing through Classes 2 and 3 to Classes 4 and 5, the flow of water in the connecting bodies being such that the interval between a water's relative purity and its gross pollution is less than 24 hours. The danger and infectivity of a human pollution less than 24 hours old is not a question to speculate about; it is something to be faced with preventive measures such as filtration and sterilization of water supplies, aided by disinfection of the polluting sewage as the exigency of the situation may demand.

Intermittency of Pollution.

The average sheets present in somewhat concise form the information relating to each sample collection point. It will be observed that in many situations it is the intermittency of serious pollution wherein lies the great menace to water supplies.

We desire to accentuate the importance of the maximum as an index of intermittency. The maximum shows what may happen in a single day at any time. Averages give a very good idea of the general condition of the water, but do not show the extraordinary fluctuations which may occur on single days.

It is a well-known fact that disaster on a large scale may be the result of pollution which occurs only at infrequent intervals. Such a pollution would scarcely show in averages, but would be at once apparent if the maximum is stated. In other words, the maximum indicates the intermittency of pollution, a dangerous factor which much be reckoned with in any discussion of pollution.

Inevitable Pollution.

The seasonal effect of pollution reaching the lakes and rivers as the run-off from the watershed in time of flood following spring rains and thaws was nil during the investigation herein reported upon. It may at certain seasons of the year become considerable, depending upon the population, the number of cattle on the watershed, and the local topography. This pollution (with its menace) is practically inevitable.

Pollution from Vessels.

There is considerable, and in some localities, a dangerous pollution due to navigation; that is, the discharge of untreated excreta from passing vessels.

Evidence is presented in the appendix, page 381, which shows that practically all vessels on the Great Lakes discharge their sewage directly into the water.

The quantity of pollution contributed by vessels may be appreciated when it is considered that the population on lake vessels has been estimated by U.S. Census Reports as 14,000,000 persons taking passage during the season 1906.

Pollution from Urban Sewage.

At the present writing every municipality, without exception, in the area investigated on the Great Lakes and their connecting rivers, avails itself of the opportunity to discharge its sewage untreated into these international waterways. This is the largest factor in their pollution. See appendix maps.

Distribution and Stratification of the Existing Pollution.

It may be observed from the chart that the bulk of the work was done on the connecting rivers and contiguous ends of the Lakes. Surface samples were found to be a fair index of the character of the water, especially where the combined effects of wave action, current, eddies and navigation lend themselves to distribution and dilution. Surface and deep samples were taken simultaneously at certain points in the St. Clair, Detroit and Niagara Rivers in order to definitely show this.

Vertical stratification, or the phenomenon of "pollution hugging the shore," may be met with in any depth. Some very striking examples are shown, especially in the St. Clair and Niagara Rivers. Horizontal stratification also occurs.

Local conditions were found to affect both dilution and stratification. These are dependent principally upon the current velocity of the diluting body, the bulk of the pollution (small sewer, main intercepter, polluted stream), and depth of sewer outlet. On the St. Clair and Detroit Rivers the sewers on the United States side all discharge at the surface, while on the Canadian side the outlets are all submerged. On the upper Niagara the principal outlets are all deeply submerged. The situations under investigation were so complex, owing to the numerous sewer outlets, that it was found impossible to demonstrate, from the data obtained, the sedimentation that one naturally expects to be taking place.

Distance that Pollution May Travel in the Lakes.

The distance that pollution may travel in the Great Lakes was well demonstrated by investigations made during the progress of the work. It was found that the boundaries of the zone of pollution along the shores or at the mouths of rivers were constantly changing, due to the currents, which are themselves dependent upon the direction and velocity of the wind. In two situations, namely at the mouths of the Detroit and Niagara Rivers, serious pollution extends normally over ten miles into the lake receiving the discharge. At times it may travel much farther. It was shown to travel in Lake Ontario on occasion sixteen miles, and in Lake Erie eighteen miles.

Pollution in Relation to Bathing Beaches and Summer Resorts.

In addition to the effect of sewage pollution upon the public health through public water supplies, its influence upon the water of bathing beaches and summer resorts must be seriously considered. It will be readily appreciated how dangerous it must be for children and adults to bathe in sewage-laden water. The water in the vicinity of the bathing beaches in the lower portion of the Detroit River was shown to be laden with sewage.

Great Lakes Water as a Source of Municipal Supply.

The distance from municipalities of pure water in the Lakes, engineering difficulties both in placing and tunnelling to reach intakes located several miles from shore and below the 70-feet depth, and the cost of such tunnels and long pipe lines make it economically inadvisable in most instances, that is under existing conditions, to attempt to secure water from the lakes which would not require treatment.

The Water Supplies in the Great Lakes Cities are not Safe Without Treatment.

The position of the intakes and the pollution existing in the vicinity of municipal water supplies is such that there is not a municipality using lake water which can be said to possess a safe water supply without treatment. In spite of these facts until very recently the use of untreated water was the rule. The conditions responsible for the disgraceful record of water-borne typhoid in these cities are:

1. Unrestricted discharge of sewage by municipalities and vessels.
2. Failure to purify polluted water.
3. Inefficiency in the purification.

In certain localities the pollution is so great as to impose an unreasonable burden upon any known method of water purification, and where intakes are located in such localities some method of eliminating or reducing the pollution, whether from boats or municipalities, is absolutely necessary.

The failure to install a water purification plant is usually due to an undue confidence in a water supply which is safe "most of the time." It is difficult for some officials to understand, without a severe lesson, that it is not sufficient to have a water supply that is safe for 360 or 361 days in the year, and to these officials it seems scarcely justifiable to require expensive purification for the sake of the four or five days in the year in which, due to weather conditions, pollution may take place. Such a supply, with a favorably placed intake, may escape pollution for more than a year. There was no evidence of serious pollution of the water supply of the city of Erie* from 1909 to December, 1910, yet the appalling disaster of January and February, 1911, showed that pollution could take place under certain weather conditions. Many similar examples might be cited.

* Hygienic Laboratory Bulletin 77. United States Public Health Service.

Danger in Assuming Water Supplies to be Safe Without Proper Evidence.

These untreated water supplies are in many instances delivered to the consumer as safe. It is our opinion that no water should be classed as safe and furnished as such which is not shown to be safe by daily bacteriologic examination.

Necessity for Sanitary Surveys.

Opinions based upon a few widely scattered bacteriologic examinations or samples of municipal water supplies collected at random have really very little value even though the tests appear to indicate good water. The public are apt to base their opinion of a water supply upon such tests. This is a dangerous error. Any report upon a water supply is incomplete without a comprehensive sanitary survey. The possibility of a serious pollution even as an exceptional occurrence would be disclosed by this survey.

Inefficient Operation of Water Purification Plants.

Inefficient management of any form of a water purification plant may be productive of disastrous results. In one, the capacity may be unduly forced; in another, the coagulant may be used in insufficient dose; in a third, the hypochlorite may be below strength, or the dose may be intermittently applied. For instance, in a town on the United States side the man in charge of the mechanical filtration plant thought a coagulant non-essential and failed to use it. At a Canadian town the waterworks superintendent, acting under instructions of the chairman of the water board, reduced his quantities of hypochlorite and obtained practically no efficiency whatever.

Necessity for Bacteriologic Control of Municipal Purification Plants.

Information collected during this investigation shows that for lack of *daily* bacteriologic examination satisfactory efficency is not being obtained by the purification methods adopted by many of the municipalities attempting to protect themselves against the consequences of polluted water supplies.

REPORT OF INVESTIGATION RE POLLUTION OF RAINY LAKE, RAINY RIVER AND LAKE OF THE WOODS. LABORATORY HEADQUARTERS AT FORT FRANCES, ONT. FIELD EXAMINATIONS COVERED THE PERIOD JULY 8th—JULY 22nd, 1913.

Fig 1

Samples examined in Rainy Lake show pollution which one would not expect in a water with so little habitation about it. Some of this pollution could, no doubt, be accounted for by the fact that the Canadian Northern Railway construction camps had been working there, putting in a big fill across Rainy Lake. The construction camps and their operations were within a few miles of the points where samples were taken. The samples show intermittency of pollution. (Figure 1.)

The cross-section at head of Rainy River, just above the village of Ranier, showed an increase of pollution which would naturally be expected owing to the construction camps and lumber mills lying along the Canadian shore in this vicinity, together with the effects of the fish industry and some summer resort pollution just above this point on the United States shore and to convergence and concentration of surface waters at this point.

Approaching the town of Fort Frances, the next cross-section shows a further increase of pollution. This is in the immediate vicinity of a summer camp and just below the village of Ranier.

The cross-section taken lower down in a wider part of the river, above Fort Frances waterworks intake, shows much the same degree of pollution. (Figure 2.)

Figure 1.—Rainy Lake. Daily variation in B. Coli findings, illustrating intermittency of pollution. Maximum pollution shown is 100 B. Coli per 100 c.c. of water. Sampling points 3, 6, 10, 12 and 17.

FIG 2.

The samples collected from the international bridge connecting Fort Frances with the town of International Falls showed considerable pollution on the United States side above their waterworks intake. (Figure 3.) This can only be accounted for by local drainage, possibly of the mills and buildings around the ferry dock above the intake. The samples obtained from the Canadian side do not show quite so great a pollution, although it is of a dangerous type.

Figure 2.—Rainy River. Daily variation in B. Coli findings above Fort Frances Waterworks intake, showing increase of pollution over that existing in Rainy Lake. Maximum pollution shown is 100 B. Coli per 100 c.c. of water. Sampling points 32, 33 and 36.

The cross-section well below the drainage of Fort Frances and International Falls showed a very large increase in the degree of pollution. The gross pollution now found uniformly throughout the river is clearly due to the sewage discharged from these two towns. Samples from other sections were taken at varying distances from this point to just above the village of Emo, a distance of twenty-two miles. These showed practically no alteration in the condition of the river.

Samples taken in the tributary streams near their mouths indicated that the water from these streams did not affect pollution of the main river during the period of the investigation.

FIG 3

Figure 3.—Rainy River. Daily variation in B. Coli findings above International Falls Waterworks intake. Sampling point 38. Irregular line at top of maximum indicates more than 100 B. Coli per 100 c.c. of water.

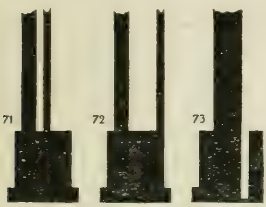

FIG 4.

The samples taken from just above Baudette, Minn., and Rainy River, Ont., showed that the degree of pollution was unchanged. Thus for sixty miles the pollution is practically uniform. The cross-sections below the towns showed an increase in pollution of more than 25 per cent.

In order to find the effect of the polluted Rainy River on the waters of the Lake of the Woods, a cross-section was run from Zippel to Bigsby Island, a distance of eighteen miles, in which 105 samples were taken. These showed a more or less uniform pollution throughout this end of the lake.

Figure 4.—Rainy River. Daily variation in B. Coli findings showing gross pollution at sampling points 71, 72 and 73. Irregular line at top of maximum indicates more than 100 B. Coli per 100 c.c. of water.

In general the Rainy River shows serious pollution throughout its length, but in an increased degree below Fort Frances and International Falls to the Lake of the Woods, making this whole river an unsafe source of water supply without very careful purification. The tap water of the towns of Fort Frances, International Falls and Rainy River was examined and shown to be of the same character as that of the river, the source of supply.

REPORT OF INVESTIGATION RE POLLUTION OF LAKE SUPERIOR AT THUNDER BAY. LABORATORY HEADQUARTERS AT PORT ARTHUR, ONT. FIELD EXAMINATIONS COVERED THE PERIOD JULY 28th— AUGUST 19th, 1913.

The examination of the waters of Thunder Bay showed that the pollution found there did not reach the international boundary, some thirty-five miles distant, during the period of the investigation. The combined population of Fort William and Port Arthur is at present only about 40,000, and with the enormous volume of water available for dilution of the sewage of these cities it is unlikely that existing pollution could reach the boundary.

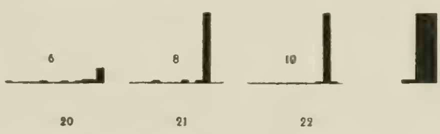

FIG 5

Figure 5.—Thunder Bay, Lake Superior. Daily variation in B. Coli findings showing intermittent pollution. Sampling points 6, 8, 10, 20, 21, and 22. Maximum pollution shown is 100 B. Coli per 100 c.c. of water. Figure to right indicates diagrammatically the exceptional pollution that occurred August 9th due to the presence of harbor water at sample points 6, 7, 8, 9, 10.

Fig 6

The local situation is, however, an unfortunate one for these cities, the general tendency being to the spread of the sewage-polluted water along the shores rather than out into the bay. The samples showed that the pollution ran either towards Papoose Island to the north or towards Pie Island to the south. On no occasion was it found beyond the Welcome Islands.

Figure 6.—Thunder Bay, in vicinity of Port Arthur Waterworks intake. In contrast with Fig. 5 serious pollution is here shown. Maximum pollution shown is 100 B. Coli per 100 c.c. of water. Sampling points 39, 40, and 41.

At times pollution from Port Arthur was found to extend along the north shore for a distance of nine miles—conditions of pollution which would seriously menace an untreated water supply taken from that source (See Fig. 6.)

Examinations of the tap water of these two cities showed that while the Loch Lomond water used by Fort William was practically pure, that of Port Arthur, taken from Thunder Bay, showed a serious pollution on several occasions.

The typhoid rate of Port Arthur is several times greater than that of Fort William —Typhoid Table No. xxv. This can only be attributed to the water supply, since the sanitary conditions of Port Arthur are undoubtedly superior to those of Fort William.

REPORT OF INVESTIGATION RE POLLUTION OF ST. MARY'S RIVER. LABORATORY HEADQUARTERS AT SAULT STE. MARIE, ONT. FIELD EXAMINATIONS COVERED THE PERIOD JUNE 28th—JULY 17th, 1913.

The population upon the drainage area of Whitefish Bay, at the head of St. Marys River, is practically nil, but the lake traffic passing through this part of the river is enormous. Samples in the ship channel along the first cross-section extending from Gros Cap to a point above Bay Mills showed the average pollution to be greater than

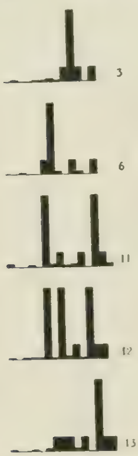

Fig 7

Fig 8

Fig 9

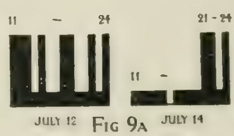

Fig 9A

that existing between the ship channel and the shore. Obviously this pollution is due to boat traffic. Inshore samples show some pollution probably due to drift from the boat channel.

Figure 7.—St. Mary's River. Daily B. Coli findings, showing effect of pollution due to vessel traffic. Sampling points 3, 6, 11, 12, and 13. Maximum pollution shown is 100 B. Coli per 100 c.c. of water.

Figure 8.—St. Mary's River. Daily variation in B. Coli findings, showing increase in pollution due to convergence of vessel traffic just above the town of Sault Ste. Marie. Sampling points 14, 15, and 16. Maximum pollution shown is 100 B. Coli per 100 c.c. of water.

Figure 9.—St. Mary's River above Waterworks intake, Sault Ste. Marie, Mich. Pollution due to vessels. Sampling point 20. Maximum pollution shown is 100 B. Coli per 100 c.c. of water.

Figure 9A.—St. Mary's River. Contrasting results on July 12th with those of July 14th. Sampling points from 11 to 24. Maximum pollution shown is 100 B. Coli per 100 c.c. of water.

The second cross-section between Brush Point and Point aux Pins showed in this narrow channel concentration of the pollution found higher up. (See Fig. 8.)

The third cross-section, just above the waterworks intake of Sault Ste. Marie, Mich., showed practically the same degree of pollution as the previous one. Water from this vicinity ought not to be furnished by the municipality without adequate

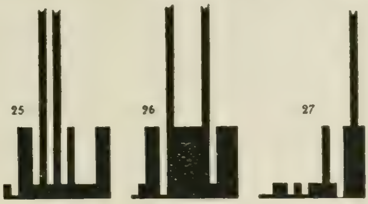

FIG 10

Figure 10.—St. Mary's River above Waterworks intake of Sault Ste. Marie, Ont. Daily variation in the B. Coli findings. This pollution is almost entirely due to navigation. Sampling points 25, 26, and 27. Maximums with an irregular line at top represent gross pollution in excess of 100 B. Coli per 100 c.c. of water.

treatment of some kind. The pollution of the water shown here probably explains the continued excessive typhoid rate of this city, especially during the navigation season.

The samples from the points above the Canadian ship channel showed great increase of pollution, much of which is probably due to the concentration of shipping at this point. The use of water from such a source is extremely dangerous. Unfortunately, the water supply of Sault Ste. Marie, Ont., is taken from the river just below these points. Acute outbreaks of typhoid must always be expected from the use of

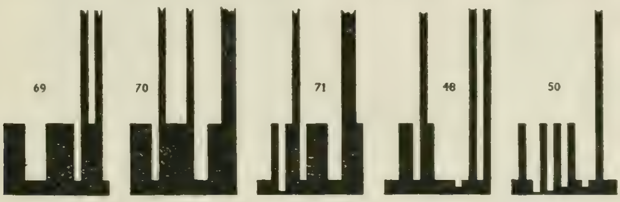

FIG 11

Figure 11.—St. Mary's River. Daily variation in B. Coli findings, below cities of Sault Ste. Marie. Sampling points 48, 50, 69, 70, and 71. Maximum pollution greater than 100 B. Coli per 100 c.c. of water.

such seriously polluted water. (Fig. 10.) The typhoid rates of this town have been excessively high for many years. See appendix for typhoid rates.

Samples taken from cross-sections below the towns showed gross pollution continuously. The pollution was found to extend, practically undiminished, to Neebish Island. This whole section of the river is a very unsafe place from which to replenish the water tanks of vessels. The pollution is general throughout the river in both channels. The fact that pollution was found to be common to both channels is of importance to summer residents who frequently use water from this polluted river.

A series of running samples through Detour Passage to Mackinac Island showed colon in practically every sample (50 c.c.). This pollution is probably due to navigation, the samples being taken in the line of boat traffic.

REPORT OF INVESTIGATION RE POLLUTION OF THE LOWER END OF LAKE HURON. LABORATORY HEADQUARTERS AT PORT HURON, MICH., AND SARNIA, ONT. FIELD EXAMINATIONS COVERED THE PERIOD JULY 3rd—AUGUST 25th, 1913.

The examination of samples in the lower end of Lake Huron showed that this water would be practically pure were it not for the pollution due to boat traffic. That portion within a radius of three miles from Point Edward Light (this portion of the Lake is shown on plate 8) showed a slight though definite pollution. The sample points near the shore on both Canadian and United States sides (plate 8) gave an average of 15 B. Coli per 100 c.c. The slight general pollution found within this portion of Lake Huron, while due in part to the large summer population and seasonal effect of streams, must be accounted for chiefly by the enormous boat traffic through the middle of this area.

REPORT OF INVESTIGATION RE POLLUTION OF RIVER ST. CLAIR. LABORATORY HEADQUARTERS AT PORT HURON, MICH., SARNIA, ONT., AND DETROIT, MICH. FIELD EXAMINATIONS COVERED THE PERIOD JULY 9th—AUGUST 25th, 1913.

The cross-section at the head of the river showed a slight increase in pollution over the water of the lake, probably due to the concentration of boat traffic.

The cross-section above the mouth of the Black River showed a continued increase of pollution due to the sewage discharged by Port Huron above this point, and undoubtedly affected by the back currents in Sarnia Bay.

Samples from points 57, 58 and 59 taken from the Black River show an average count of 3,400 B. Coli per 100 c.c.

The two cross-sections taken below the mouth of the Black River showed an enormous increase in pollution in the St. Clair on the United States side. The pollution of the United States side is due to the sewage of Port Huron, while the pollution of the Canadian side is due to the sewage of Sarnia.

The cross-section just below the site of the International Tunnel continues to show marked pollution along both shores, illustrating vertical stratification.

The two cross-sections above Stag Island showed gross pollution extending a little

Fig 12.

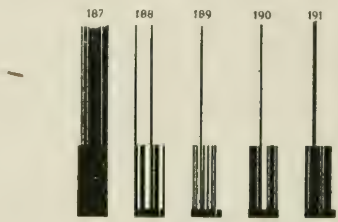

Fig 12a

Figure 12.—Head of St. Clair River. Showing vessel pollution variation on different days: left figure Aug. 8th, central figure Aug. 11th, right figure Aug. 12th. Sampling points 41, 42, 43, and 44 from left to right. Maximum pollution shown is 100 B. Coli per 100 c.c. of water.

Figure 12A.—St. Clair River. Daily variation in B. Coli findings. Showing the marked irregularity of gross pollution near mid-stream The shore samples are continuously polluted. Sampling points 187, 188, 190, and 191. Irregular line at top of maximum indicates gross pollution in excess of 100 B. Coli per 100 c.c. of water.

farther towards the centre of the stream, while the two below this island showed that gross pollution extended over the entire width of the river.

The waters of the River St. Clair from its head to Lake St. Clair are unsafe as a source of water supply without careful and unremitting purification.

The several cross-sections from St. Clair to Algonac show gross pollution of the river, more marked on the United States than on the Canadian side, owing to the fact that the discharge of sewage is chiefly from the United States side, the Canadian municipalities below Sarnia not being sewered.

Samples collected along the cross-sections at the branches of the delta where the river discharges into Lake St. Clair showed the main ship channel to be the least polluted, the bulk of the pollution existing on each side having passed through the Chenal Ecarté and North Channel respectively.

REPORT OF INVESTIGATION RE POLLUTION OF LAKE ST. CLAIR. LABORATORY HEADQUARTERS AT DETROIT, MICH., AND WINDSOR, ONT. FIELD EXAMINATIONS COVERED THE PERIOD MAY 23rd—OCTOBER 6th, 1913.

The bulk of the eastern portion of Lake St. Clair was shown to be comparatively pure.

Samples taken from the lake near the points where the Thames and Clinton Rivers discharge, indicate that these rivers do not affect the general character of the lake water beyond a very short distance from their mouths. The examinations were made in July and August, and it is quite probable that when these streams are in flood, for instance in April, the pollution would extend farther out into the lake. Excluding the tributary streams, the largest of which (Thames and Clinton) were shown to have no appreciable effect at this season, there exists the pollution from the St. Clair River and the sewage discharged from vessels.

It will be remembered that cross-sections at the delta of the St. Clair River showed that the bulk of pollution left the river by the right-hand or North Channel and the Chenal Ecarté. The purer water with a relatively slight pollution entered the lake by the south channel (main ship channel).

The cônditions in Anchor Bay and that very shallow portion of the lake north of the St. Clair Flats Canal are favorable for the action of sedimentation and other agencies which thin out and diminish pollution. As the drift from this portion of the lake is south toward the main ship channel, some pollution reduced by the natural agencies just mentioned probably again reaches the main ship channel.

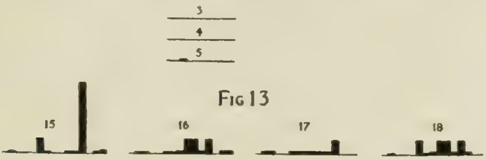

Fig 13

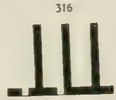

Fig 14.

Figure 13.—Lake St. Clair. Daily variation in B. Coli findings. Sampling points 3, 4, and 5 from eastern portion of lake show almost entire absence of pollution. Sampling points 15, 16, 17, and 18 in the line of vessel traffic show varying pollution. Maximum pollution shown is 100 B. Coli per 100 c.c. of water.

Figure 14.—Lake St. Clair. Daily variation in B. Coli findings. Sampling point 316 in direct line of vessel traffic. Maximum pollution shown is 100 B. Coli per 100 c.c of water.

Samples taken from a cross-section in mid-lake crossing the boundary half-way between the lower entrance of the St. Clair Flats Canal and Peach Island showed an average pollution of about 6 B. Coli per 100 c.c of water in the vicinity of the ship channel and from this point to the United States shore. The Canadian portion of the lake is south and east of the line of vessel traffic (sample points 3, 4, 5, fig. 13) and, as already stated, showed very little pollution.

The effect of vessel pollution is considerable, and a series of samples taken from a passenger steamer in the direct line of traffic showed the average pollution in the ship channel from the St. Clair Flats to Belle Isle to be about 21 B. Coli per 100 c.c. of water.

REPORT OF INVESTIGATION RE POLLUTION OF DETROIT RIVER. LABORATORY HEADQUARTERS AT DETROIT, MICH., WINDSOR, ONT., AND AMHERSTBURG, ONT. FIELD EXAMINATIONS COVERED THE PERIOD MAY 23rd —OCTOBER 14th, 1913.

Samples taken along a cross-section where the Detroit River leaves Lake St. Clair showed about the same degree of pollution as the lake in the centre of the channel, with increased pollution close to the United States shore.

Fig 15.

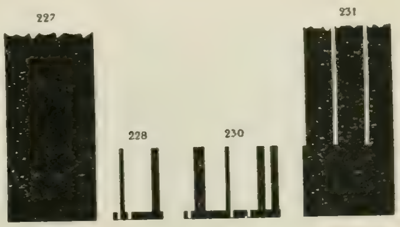

Fig 16

Figure 15.—Head of Detroit River. Daily variation in B. Coli findings. Intermittent pollution probably due to vessel traffic, Sept. 4 to 23, 1913. Sampling points 41, 43, 45, and 47. Maximum pollution shown is 20 B. Coli per 100 c.c. of water.

Figure 16.—Detroit River at M.C.R.R. Tunnel. Daily variation in B. Coli findings, showing enormous constant pollution at shore sampling points 227 and 231 and intermittent pollution at sampling points 228 and 230. Irregular line of maximum indicates gross pollution greatly in excess of 10,000 B. Coli per 100 c.c.

Samples taken along a cross-section at the head of Belle Isle showed considerable pollution near both shores. This is enormously increased at the next cross-section, especially at the sample points near the United States shore. The results of our analyses of samples taken above the intake of the Detroit city water supply showed this to be an unsafe source of supply without careful treatment. The application of hypochlorite of lime in the quantities or by the method in vogue in Detroit during our investigation does not, in our opinion, represent adequate treatment.

Samples taken along the several cross-sections from this point to the site of Michigan Central Tunnel showed a marked increase of pollution in the shore samples.

The water intakes of Walkerville and windsor are both located in dangerous situations, owing to the discharge of sewage above these intakes and to the pollution due to navigation. In spite of the efforts made by these towns to protect their supplies by means of chlorination, the typhoid rates remain too high. At times the pollution is si great that the quantity of chlorine required to overcome it gives objectionable taste to the water.

Investigation made of the effectiveness of chlorination in Windsor and Detroit showed that there were frequent breaks in its efficiency. These were due to lack of uniformity of the available chlorine content of the hypochlorite used, the tendency to reduce the necessary quantities on account of complaints of taste, and of intermittency in its administration.

Samples taken from a cross-section over the Michigan Central Railroad Tunnel showed a gross pollution at sample points near the Canadian and United States shores, and a considerable pollution extending across the entire river. (Fig. 16.)

Samples taken from several cross-sections showed gross pollution throughout the entire river from the Michigan Central Railway Tunnel to Fighting Island.

From Fighting Island to the mouth of the river that water is grossly polluted and totally unfit as a source of water supply. It is our opinion that such raw water would impose an unreasonable responsibility on any known method of purification, even with most careful supervision. Unfortunately, Wyandotte, Trenton and Amherstburg are taking their water supplies from this part of the river.

The distribution and course of pollution are shown by the sketch, No. 1 (page 59). This shows the B. Coli average in figures for several of these cross-sections.

Fig 16A

The B. Coli content per 100 c.c. has increased from below 5 in Lake St. Clair water to an average of 315 at the head of Fighting Island. Fighting Island divides the river into two channels. There is a great difference in the degree of pollution in these two channels. In the channel between the United States shore and Fighting Island the pollutio is enormous. The channel east of Fighting sland shows gross pollution, but very much less than that in the United States channel. The extensive pollution of the Lower Detroit River is shown by the averages presented on above sketch and reach the considerable figure of 11,592 B. Coli per 100 c.c. as is shown.

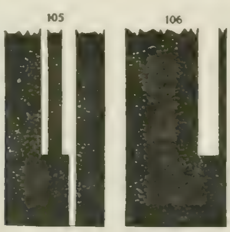

Fig 17

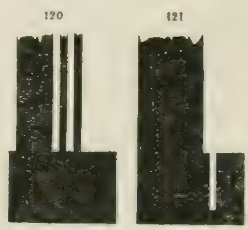

Fig 18

Figure 16A.—Detroit River cross-section above Fighting Island, sampling points 93 to 101, inclusive. Showing daily variation across this section on Sept. 6, 13, 18, and 27, 1913. Irregular line at top of maximum indicates gross pollution in excess of 100 B. Coli per 100 c.c. of water.

Figure 17.—Detroit River above Waterworks intake of Trenton, Mich. Showing constant gross pollution daily. The average for these three sampling points 105, 106, 107, was over 11,000 B. Coli per 100 c.c. of water.

Figure 18.—Detroit River near bathing beaches, lower end of Grosse Isle. Sampling points 120 and 121. Showing that gross pollution is constantly present. An average B. Coli content of 2,675 per 100 c.c. of water was obtained in this neighborhood.

REPORT OF INVESTIGATION RE POLLUTION OF THE WESTERN END OF LAKE ERIE. LABORATORY HEADQUARTERS AT DETROIT, MICH., AMHERSTBURG, ONT., AND ON BOARD THE REVENUE CUTTER "MORRILL." FIELD EXAMINATIONS COVERED THE PERIOD JUNE 11th—OCTOBER 2nd, 1913.

An extensive investigation was made of the area at the mouth of the Detroit River and western end of Lake Erie to Put-In Bay. The results of the examination of a large number of samples taken over this area show the existence of gross pollution, and the water in this part of the lake is unquestionably dangerous to crews and passengers of vessels using water pumped from this region.

In our opinion there is no point from the lower end of Lake Huron to the islands which separate the western end from the remainder of Lake Erie from which a safe supply of water could be taken for any considerable portion of the 365 days in year.

The limit of the Western End of Lake-Erie pollution is probably in the vicinity of the islands which separate this portion from the remainder of the lake.

REPORT OF INVESTIGATION RE POLLUTION OF THE CENTRE AND EASTERN PORTION OF LAKE ERIE. LABORATORY HEADQUARTERS AT PORT STANLEY, ONT., AND FORT ERIE, ONT. FIELD EXAMINATIONS COVERED THE PERIOD MAY 26th—OCTOBER 13th, 1913.

At Port Stanley the evidence indicates that Lake Erie is pure and that where pollution is picked up in the neighborhood of any local source of contamination it is confined to that locality.

This condition is shown by the almost entire absence of B. Coli in the samples examined, even in 75 c.c. quantities.

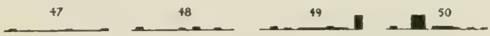

FIG 19

Figure 19.—Niagara River opposite Fort Erie, Ont. Daily variation in B. Coli findings. Sampling points 47, 48, 49, and 50. Maximum pollution shown is 20 B. Coli per 100 c.c of water.

Samples collected in the lake along a line from Point Abino to the United States shore about twelve miles above Buffalo show the waters of the eastern end of Lake Erie to be pure, except as they may be influenced by the effect of navigation. This condition is further emphasized by the examination of samples taken from the cross-sections at the foot of the lake before its waters become the Niagara River. It was found during the period of investigation that pollution from Buffalo and other sources extended but a short distance beyond the breakwaters, and that the water from there across the boundary almost to the Canadian shore is relatively pure, except as directly influenced by navigation.

REPORT OF INVESTIGATION RE POLLUTION OF NIAGARA RIVER. LABORATORY HEADQUARTERS AT BUFFALO, N.Y., AND FORT ERIE, ONT. FIELD EXAMINATIONS COVERED THE PERIOD MAY 12th—July 29th, 1913.

The examination of samples taken from the first cross-section of the Upper Niagara River showed relatively pure water on the Canadian side and the beginning of noticeable pollution from Buffalo Harbor. From the next cross-section to the one below Squaw Island the pollution, though greatly increased in quantity on the United States side, was held to that shore. The pollution on the Canadian side, though of less extent, was likewise confined to its shore. This phenomenon is due to the immense volume and the great velocity of the river, and the depth of the outlets of the Buffalo sewers. After passing Strawberry Island the pollution tended to extend across the entire Tonawanda Channel, and from Rattlesnake Island to the point where it again joins the main river the whole channel was shown to be grossly polluted. The use of this water as a public supply, even with the stringent purification, is attended with considerable risk.

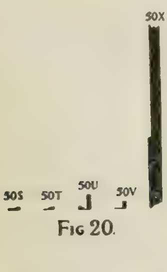

FIG 20.

Figure 20.—Niagara River opposite Fort Erie, Ont. Showing vertical stratification of pollution. Sampling points 50S, 50T, 50U, 50V, and 50X. Irregular line at top of maximum indicates gross pollution in excess of 100 B. Coli per 100 c.c. of water.

Examination of samples collected in cross-sections in the Chippewa Channel (International Boundary Channel) shows that the pollution, while definite in character, is not so great in degree as that in the Tonawanda Channel. The pollution sometimes found in the Chippewa Channel cannot be fully accounted for by the drainage of Fort Erie and Bridgeburg. It is probable that a portion of the Buffalo sewage at times reaches this channel.

Fig 21

The examination of samples taken from cross-section below Buckhorn and Navy Islands showed undiminished pollution on the United States side. On the Canadian side, the water, though less polluted, was still dangerous and should not be used without the most careful treatment; otherwise its use is liable to give rise to periodic epidemics of intestinal diseases.

The results from the examination of samples collected in the Gorge just below the two Falls demonstrated that the pollution coming over is more uniformly distributed. There is a popular impression that the action of the Falls tends to purify sewage. It simply mixes it more thoroughly with the water; it does not remove it or its danger. The pollution below the Falls is gross.

Figure 21.—Niagara River, Chippewa Channel. Daily variation in B. Coli findings. Intermittent pollution very slight in sampling points 65 and 66. Maximum pollution shown at sampling point 65 is 20 B. Coli per 100 c.c. of water. Contrast this slight pollution found in May and June with the average serious pollution found in the same channel in July shown on investigation chart, Plate No. 17.

REPORT OF INVESTIGATION RE POLLUTION OF LOWER NIAGARA RIVER AND WESTERN END OF LAKE ONTARIO. LABORATORY HEADQUARTERS AT NIAGARA-ON-THE-LAKE, ONT., AND YOUNGSTOWN, N.Y. FIELD EXAMINATIONS COVERED THE PERIOD MAY 28th—AUGUST 21st, 1913.

Before arriving at Lewiston the river passes over the Niagara Falls and through the Great Gorge. The mixing of the sewage affected by the Falls and Rapids with the river water is probably the most complete possible. The samples examined showed that from this point to the mouth of the river the water was uniformly polluted from shore to shore, and emphasized the fact that the use of water from this section of the river as a public water supply without the most careful and exacting purification should not be considered.

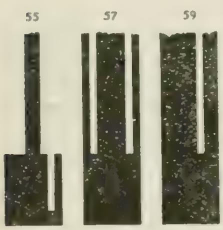

Fig 22

The conditions found at the mouth of the Niagara River differ from those found at the mouth of the Detroit River. At the mouth of the Detroit River the discharge is into an enclosed end of the lake, where it is lagooned and drifted from point to point for a considerable time before it can get into the lake itself. At the mouth of the Niagara, the pollution is being discharged into a portion of the lake where conditions are such that the drift may take place north, east or west. Several limits of this polluted area were determined with a considerable degree of accuracy. A striking phenomenon exhibited was that very little diminution in pollution occurred until the limiting boundaries of the area were reached. For example, if at the mouth of the river pollution was such as would show 1,000 B. Coli per 100 c.c., the pollution ten miles from shore, wind conditions being favorable to put it there, would show practically the same degree of pollution.

The menace in this area is almost entirely directed at the present time towards navigation between Buffalo and Toronto. Further samples taken from the passenger boats along cross-sections from Niagara-on-the-Lake and other lake points in this vicinity to Toronto corroborated the observation that this polluted area extended as far as ten, twelve and even sixteen miles on occasion. It is reasonable to suppose that more favoring conditions than those occuring in the limited period of our observation would drift the pollution farther out.

At the present time the boats carrying passengers back and forward across this route have insufficient tankage to provide their patrons with safe water during the entire journey. They replenish *en route*, often from polluted areas. The many samples collected from their drinking-water taps showed on several occasions dangerous pollution.

Figure 22.—Niagara River at Lewiston, showing the effect of the Falls and Rapids in distributing a gross pollution uniformly throughout the cross-section. Maximum with irregular line at top indicates pollution in excess of 1,000 B. Coli per 100 c.c. of water. Sampling points 55, 56, 57, 58, 59.

REPORT OF INVESTIGATION RE POLLUTION OF THE EASTERN END OF LAKE ONTARIO AND ST. LAWRENCE RIVER. LABORATORY HEADQUARTERS AT KINGSTON, ONT., CLAYTON, N.Y., AND MONTREAL, QUEBEC. FIELD EXAMINATIONS COVERED THE PERIOD APRIL 15th—SEPTEMBER 3rd, 1913.

The work at the lower end of Lake Ontario and on the St. Lawrence River was performed at two distinctly different seasons by different laboratories.

The work done early in the season before navigation commenced showed Lake Ontario water practically sterile; the work done later, in August, showed minor pollution in the lake. The difference in the findings emphasizes the effect of boat traffic and summer residents' pollution.

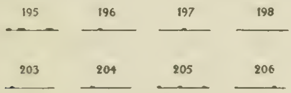

Fig 23

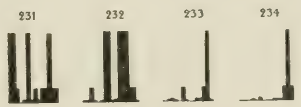

Fig 24

Figure 23.—Lake Ontario, head of St. Lawrence River. Daily variation in B. Coli findings, showing almost entire absence of pollution in April and May. Sampling points 195, 196, 197, 198, 203, 204, 205, and 206. Maximum pollution shown is 2 B. Coli per 100 c c. of water.

Figure 24.—St. Lawrence River below Kingston, Ont., at Knapp's Point. Daily variation in B. Coli findings, showing effect of Kingston sewage April 15 to May 17, 1913. Sampling points, 231, 232, 233, and 234. Maximum pollution shown is 100 B. Coli per 100 c.c. of water.

Examination of samples taken below Kingston at Knapp's Point showed considerable pollution. The samples taken from the vicinity of Sheriff's Point after the water had come down the Bateau Channel, showed but slight decrease of the pollution.

The results of the August investigation showed that conditions were considerably worse than those obtained in April, especially at the sample points below Wolfe Island. Much of the intermittency of pollution occurring during the April investigation in this stretch may be fully accounted for by the periodical discharge of Cataraqui Bay at Kingston. This bay is grossly polluted and its contents are discharged into the St. Lawrence River with certain wind conditions.

While examination below Wolfe Island among the Thousand Islands did not show an average gross pollution, its intermittent character presents a menace to the summer residents in this section who take their supply of water from the river without purification.

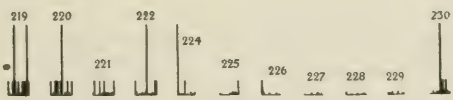

Fig 25

Figure 25.—St. Lawrence River, among the Thousand Islands. Daily variation in B. Coli findings, showing intermittent serious pollution. Sampling points 219, 220, 221, 222, 224, 225, 226, 227, 228, 229, and 230. Maximum pollution shown is 100 B. Coli per 100 c.c. of water.

Examinations made in the vicinity of Brockville showed that the shore samples collected from the cross-section above Brockville carried considerable pollution. Toward mid-stream, where dilution and mixing had taken place, the samples showed constant pollution of lesser degree. Below Brockville the major pollution remains near the banks of the river. Samples collected in mid-stream showed very ittle pollution in the early work before navigation opened. The later work in August showed a very general serious pollution, due probably to summer resort population and to boat traffic. The condition of the river between Brockville and Cornwall is very bad in the summer months, as evidenced by mid-stream samples Nos. 266-273.

Unquestionably, the water from this portion of the St. Lawrence River should not be used as a water supply without adequate purification.

REPORT OF INVESTIGATION RE POLLUTION OF THE ST. JOHN RIVER. LABORATORY HEADQUARTERS AT VAN BUREN, MAINE. FIELD EXAMINATIONS COVERED THE PERIOD OCTOBER 2nd—NOVEMBER 4th, 1913.

The St. John River forms the international boundary between Canada and the United States for about seventy miles of its course. The investigation was limited to that portion of the river between Edmunston and Grand Falls. This portion of the river forms the boundary for thirty-five miles and leaves the boundary entering Canadian territory three miles above Grand Falls.

Sources of Pollution.—There are no large urban communities in the drainage area of this portion of the river. In these small towns the bulk of the population depends upon cesspools and privies, owing to the lack of proper sewerage. Van Buren, Maine, population 1,900 has three small sewers, two discharging into Violette Brook and one directly into the river. These serve about 150 persons.

St. Leonards, N.B., has no municipal sewerage system. There is one sewer outlet from the Cyr Hotel direct into the river.

The direct sewage pollution of the St. John River from Edmunston to Grand Falls is at present slight. There is a considerable rural pollution due to the drainage from small communities, manured fields, cesspools and other sources, which may be considered inevitable, especially after rains, thaws and floods. There are seven potato starch factories which have considerable effect upon the pollution of the river.

An average for this portion of the river during the period of investigation might be tentatively expressed as follows:

Average number of B. Coli per 100 c c.	125
Average number of bacteria per c.c. on agar at 37° C.	250

The rises in pollution noted are due to various causes, that below Edmunston being probably due to drainage from the village.

Increase is to be expected at Grand Isle because of the drainage from the town and wastes from the potato starch factory. A slight rise below the mouth of Grand River is probably due to pollution carried by that stream. The rise below Van Buren is due to sewage and drainage from Van Buren and St. Leonards, plus the wastes from potato starch factories on Violette Brook and Toussant Brook.

The rise at sampling points 28 and 29 is due to pollution of Rafael Brook, which also carries the waste of a potato starch factory.

In considering the pollution of the St. John River below Edmunston and Grand Falls there will be noted at least three points where the pollution was in excess of the usual amount. These three points are below Grand Isle, below Van Buren and Toussant Brook and below Rafael Brook. Other rises in the pollution index of much lesser importance are noticeable below Edmunston, below Iroquois River, below Siegas River and below Grand River.

TYPHOID FEVER STATISTICS AND SOME SANITARY FACTS AFFECTING ITS UNDUE PREVALENCE IN ONTARIO.

(Through the courtesy of the Provincial Board of Health of Ontario.)

In considering the question of typhoid fever in the Dominion of Canada, for the purposes of this report, the Province of Ontario from the fact of its geographical position on the International waters is the portion most vitally concerned. The Province has an immense area of over 400,000 square miles. It has a frontage on the International waters, stretching from the Lake of the Woods to Cornwall on the St. Lawrence of 1,500 miles. Along this area are its chief centres of population. The older portions of the Province, abutting on the Great Lakes, are the most thickly settled. In that portion known as New Ontario, the population, except in the new and rapidly growing towns and cities on the Upper Lakes, is found chiefly on the three lines of Transcontinental railways which converge at Fort William and Port Arthur and from there stretch fanlike to the Greater West. In this newer territory the population is largely made up of the employees engaged in railway construction, in mining, and in the lumber industry. The health of the men engaged in the industries just mentioned is under close supervision by the Provincial Board of Health. The regulations of the Board define

TABLE XXV.

TYPHOID FEVER.

	FORT FRANCES. Census Pop. 1901— 466 1911—1,611		RAINY RIVER Census Pop. 1901— 1911—1,578		PORT ARTHUR Census Pop. 1901— 3,212 1911—11,220		FORT WILLIAM Census Pop. 1901— 3,997 1911—16,499		SAULT STE. MARIE Census Pop. 1901— 7,169 1911—10,984		STEELTON Census Pop. 1901— 1911-3,936		SARNIA Census Pop. 1901—8,176 1911—9,947	
	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths
1903	0	0	....	2	89	4	78	5	152	11	....	..	116	14
1904	0	0	0	0	243	15	182	14	26	2	....	..	34	3
1905	0	0	200	2	72	5	100	9	150	12	....	..	33	3
1906	96	1	200	2	422	34	960	98	191	16	87	2	55	5
1907	86	1	0	0	118	11	70	8	91	8	0	0	87	8
1908	79	1	0	0	152	16	141	18	68	6	69	2	112	11
1909	72	1	0	0	171	20	128	18	87	8	0	0	83	8
1910	400	6	0	0	179	23	98	15	153	14	0	0	102	10
1911	372	6	634	1	142	16	42	7	330	35	51	2	141	14
1912	0	0	0	0	161	23	35	7	83	10	20	1	134	14
Average	111	2	103	1	175	17	183	20	133	12	23	1	90	9

	WALKERVILLE Census Pop. 1901—1,595 1911—3,302		WINDSOR Census Pop. 1901—12,153 1911—17,829		AMHERSTBURG Census Pop. 1901—2,222 1911—2,560		SANDWICH Census Pop. 1901—1,450 1911—2,302		FORT ERIE Census Pop. 1901— 890 1911—1,146		BRIDGEBURG Census Pop. 1901—1,356 1911—1,770		NIAGARA FALLS Census Pop. 1901—5,702 1911—9,248		NIAGARA-ON-THE-LAKE Census Pop. 1901—1,258 1911—1,318	
	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths
1903	0	0	30	4	0	0	122	2	0	0	0	0	....	..	0	0
1904	47	1	59	8	0	0	182	3	108	1	0	0	14	1	78	1
1905	0	0	42	6	0	0	57	1	0	0	0	0	....	..	78	1
1906	40	1	41	6	83	2	54	1	0	0	0	0	40	3	0	0
1907	0	0	78	12	0	0	52	1	99	1	0	0	38	3	0	0
1908	0	0	60	10	0	0	100	2	0	0	0	0	73	6	0	0
1909	0	0	51	9	40	1	47	1	0	0	0	0	23	2	0	0
1910	0	0	45	8	0	0	45	1	0	0	0	0	90	5	0	0
1911	30	1	33	6	78	2	0	0	87	1	0	0	86	8	0	0
1912	57	2	55	7	115	3	125	3	0	0	0	0	41	4	0	0
Average	17	1	49	7	32	1	78	2	29	.03	0	0	40	3	16	.02

TABLE XXV.—Continued.

TYPHOID FEVER.

	HAMILTON Census Pop. 1901—52,634 1911—81,959		GRIMSBY. Census Pop. 1901—1,001 1911—1,669		OAKVILLE Census Pop. 1901—1,643 1911—2,372		TORONTO Census Pop. 1901—156,098 1911—327,753		WHITBY Census Pop. 1901—2,110 1911—2,248		BOWMANVILLE. Census Pop. 1901—2,731 1911—2,814		PORT HOPE. Census Pop. 1901—4,188 1911—5,092		COBOURG Census Pop. 1901—4,239 1911—5,074	
	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths
1903	7	4	0	0	55	1	20	38	0	0	36	1	0	0	0	0
1904	15	9	0	0	107	2	28	56	0	0	36	1	22	1	0	0
1905	20	13	0	0	0	0	18	41	0	0	0	0	0	0	0	0
1906	28	19	0	0	0	0	29	70	46	2	72	2	64	3	42	2
1907	14	7	0	0	0	0	22	58	0	0	0	0	63	3	0	0
1908	18	13	0	0	47	1	22	60	0	0	144	4	0	0	0	0
1909	14	11	66	1	46	1	26	77	45	1	144	4	81	4	20	1
1910	14	11	62	1	0	0	49	151	34	1	108	3	40	2	39	2
1911	22	18	0	0	42	1	25	82	0	0	0	0	59	3	79	4
1912	8	7	0	0	0	0	15	54	43	1	35	1	77	4	19	1
Average	16	11	13	.02	30	1	27	69	17	1	57	2	41	2	20	1

	BELLEVILLE Census Pop. 1901—9,117 1911—9,876		TRENTON Census Pop. 1901—4,217 1911—3,988		KINGSTON Census Pop. 1901—17,961 1911—18,874		GANANOQUE Census Pop. 1901—3,526 1911—3,804		PRESCOTT Census Pop. 1901—3,019 1911—2,801		BROCKVILLE Census Pop. 1901—8,940 1911—9,374		CORNWALL Census Pop. 1901—6,704 1911—6,598	
	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths	Deaths per 100,000	Total Deaths
1903	32	3	0	0	100	18	55	2	0	0	66	6	30	2
1904	10	1	0	0	22	4	0	0	0	0	66	6	45	3
1905	21	2	0	0	38	7	0	0	34	1	22	2	30	2
1906	84	8	0	0	38	7	0	0	34	1	109	10	90	6
1907	83	8	0	0	27	5	27	1	103	3	21	2	75	5
1908	72	7	0	0	32	6	0	0	34	1	43	4	105	7
1909	41	4	0	0	32	6	0	0	0	0	32	3	60	4
1910	51	5	24	1	80	15	0	0	70	2	10	1	60	4
1911	20	2	25	1	26	5	0	0	35	1	42	4	45	3
1912	40	4	24	1	30	6	0	0	0	0	63	6	60	4
Average	45	4	7	.03	43	8	8	.03	31	1	47	4	60	4

the character and location of the camps. These are not allowed close to a river, stream or lake, and the requirements respecting their construction, ventilation and sanitary conditions are strictly enforced. Each employer of labour is required to provide a physician for the care of the men employed. Monthly inspection and report upon the camps is made by the contract physician. The regulations are rigidly enforced by the District Officers of Health. In this way the Province is possessed of a very complete knowledge of the incidence of typhoid fever and other diseases occurring among this portion of the population. The records of deaths from the various diseases have been carefully collected for the last forty-three years and published in the Registrar-General's Reports; especially in the last ten or fifteen years these records are very complete and form an accurate basis for the typhoid rates included herein. The record is not one to be proud of. It will be seen that while the typhoid rate is excessive in most parts of the Province, over a long period of time, it is higher in the communities taking their supplies from rivers and streams, and highest of all in the counties and in the cities and towns situated on the International waters. The City of Ottawa, the capital of the Dominion, has had within the last three years two very marked outbreaks of typhoid, shown after careful investigations to have been caused by the use of sewage-polluted water from the Ottawa River. It is a disgraceful fact that up to the present date no satisfactory plan for a pure supply for that city has been adopted. Sarnia, on the River St. Clair, on the other hand, has profited by its experiences with typhoid fever two years ago. Its water supply is taken from the river. This, on investigation by the Provincial Board, having been shown to be the origin of the outbreak, the town has undertaken to secure a supply by infiltration from Lake Huron at a point several miles above the town. The new works will be completed during the coming summer and will ensure a safe supply.

Many of the port towns have high typhoid rates. Doubtless a good many of their cases come from the boats during the season of navigation. Some of the typhoid in these communities, especially if the town is a hospital centre, comes from the surrounding districts. But when the rates for the counties along the boundary waters are considered, and the experiences of the physicians in rural communities adjacent to the cities and towns is heard, one is forced to the conclusion that a good deal of the rural typhoid fever has its source in these urban centres. The Counties of York, Essex, Lambton and Frontenac, lying on the International waters, have had a high typhoid rate for many years.

All of the cities and towns on the International waters have had excessive rates for a long period of time. In some of them, notably Fort William, Sault Ste. Marie and Sarnia, these rates have been extraordinarily high. All of them, with the single exception of Fort William, which has had a mountain lake supply for the last half a dozen years, take their water supplies from the adjacent waters into which, without treatment, all their sewage is poured. A few, such as Port Arthur, Sault Ste. Marie, Sarnia, etc., have been required by the Provincial Board to establish emergency chlorination apparatus. The City of Toronto uses water which is treated by a slow sand filter, supplemented by chlorination. The effect of treatment in this city has shown a marked reduction in the typhoid rates during the last two years.

The use of chlorine, if properly applied, has proved to be a valuable emergency measure in the treatment of water supplies in Ontario. For a number of reasons it is not completely satisfactory. Unless the dosage is small and carefully regulated it gives rise to a great deal of complaint on account of the taste, and this is frequently made an excuse for lessening the dose to an ineffective amount or dispensing with it altogether. Its value depends upon careful regulation of the dosage, the scrupulous care of a competent staff and the oversight of a bacteriological laboratory. In Toronto, where these conditions are fulfilled, there is little complaint, and, as already remarked, the results here justify the exertions of the Health Department and city authorities.

The results of the investigation, included in this report, indicating the gross pollution of much of the International waters, due chiefly to the sewage of the urban communities in both countries, point plainly to the connection between this pollution and the high typhoid rates in their cities and towns and should surely stimulate public opinion to reduce the causes both by a proper disposal of the sewage and by providing such treatment of their water supplies as will safeguard the population against an easily preventable disease.

Rainy River and Fort Frances.

Both these places are situated on the Rainy River. They are the most westerly towns of importance on the International waters. Their water supplies are taken from the sewage-polluted river water and both have high typhoid rates. Some of this typhoid may be accounted for by the influx from the adjacent lumber woods and railway con-

struction camps. But from the character of their water supplies it seems probable that the disease is largely water-borne. These towns, as well as International Falls, on the United States side, cannot hope to obtain safe river water until the sewage is properly taken care of. In the meantime, these municipalities should filter and chlorinate their water supplies.

Fort William and Port Arthur.

These twin cities have during the last twelve years had an extraordinarily high typhoid rate. Both of them are hospital centres and receive the sick from the lumber, mining and construction camps of their neighbourhood. This accounts for part of their typhoid rate. Fort William is the larger of the two cities. Until 1909 Fort William took its water supply from the Kaministiquia River—a seriously polluted source. In 1906 the intake was broken close to shore and received gross pollution from a sewer entering the river above and nearby. Ten per cent. of the population developed typhoid. Three years afterwards the Loch Lomond supply was put into commission. Since then the typhoid rate has come down, until at the present time it is below thirty. During the big typhoid year, Port Arthur had its highest rate. There is a good deal of communication between the two towns. The water supply of Port Arthur is obtained from a point in Thunder Bay, not very far from some sewer outlets. As the town grew, the amount of sewage increased, with the result that the typhoid rate has also steadily increased, until now it is several times higher than that of Fort William, though all other sanitary conditions are better in Port Arthur than in Fort William. Throughout the greater part of the time the Port Arthur water exhibits but slight contamination, but show intermittent serious pollution. On these days of pollution the counts are not what are generally considered high, nor is the colon content large. Contrasting this with the pure bay water, it appears serious. Chlorination of the supply has been in operation in Port Arthur during the last ten months, but has been rather indifferently applied. The hoped-for reduction in typhoid has not been great.

Sault Ste. Marie.

The typhoid rate here has always been high. This also is a hospital centre for the camps of the district. This accounts for part of the typhoid. When Sault Ste. Marie, Mich., took its water supply from just above the canal locks, its typhoid rate and that of Sault Ste. Marie, Ont., paralleled each other. The Michigan city now takes its water from a point above the sewer outlets. Its rate has fallen markedly below that of the Ontario city, which still continues to take its water from the old source above the locks and still holds its old rate. The Michigan city's typhoid is about nil in the winter. It rises strikingly during the months of navigation, but earlier than the fly season, whilst Sault Ste. Marie, Ontario, has its typhoid in the winter as well as in the summer, just as Sault Ste. Marie, Michigan, used to have prior to the installation of its present intake.

If the typhoid of these cities is correctly located as to origin, we have a good illustration of the disastrous effect of slight intermittent pollution and also of the pollution derived from the boats. Even when polluted, the count is remarkably low and the colon bacillus present in small number only.

Sarnia.

This town at the head of the River St. Clair takes its supply unfiltered from the river through an intake extending about seven hundred feet into the stream. In the latter part of 1911 there was a sharp outbreak of typhoid there, and under the direction of the Provincial Board of Health, a chlorination apparatus was established. In January, 1912, the Board, acting as a commission under the Public Health Act, made a thorough investigation under oath into the whole question of the water supply and typhoid conditions in the town.*

The evidence established:

(1) That there were in the town, during the year 1911, 151 cases of typhoid, of which 136 occurred during the months of November and December.

(2) That the contaminated water supply was, especially during these latter months, the sole cause. This was evidenced by a widespread distribution over the town, the occurrence of the large proportion of cases during the cold season, the absence of other causes, as milk, etc. Contact cases were practically eliminated, it being shown by the evidence of Dr. Bentley and others that second cases in the same house occurred at the same time. The figures in respect to milk inspection were given in the evidence

* See Report of Special Investigation into the Cause of Typhoid Fever in the Town of Sarnia, 1912. Provincial Board of Health, Ontario.

of Dr. R. W. Bell. The evidence of Dr. Wilkinson respecting the prevalence of cases in a strip of territory adjacent to the St. Clair River was of especial significance.

(3) That the water supply was contaminated at various times since 1903 is shown by examinations made in the State Laboratory of Hygiene, Ann Arbor, Mich., by the bacteriologist and chemist of the Imperial Oil Company of Sarnia, and repeatedly by the officers of the Laboratory of the Provincial Board of Health at Toronto.

(4) In addition, the evidence goes to show that there is danger of pollution of the water supply from the sewage of the town, which has its outlet at the foot of Cromwell Street, a couple of blocks below the intake, through the influence of currents sweeping northward into the bay, by the disturbance of bay water by these currents, by the rising and falling of the bay waters due to north and south winds, and by the ebb and flow caused by large vessels passing up and down. Besides this there is the sewage from the steamboats and from the considerable population at the mills north of the intake, and from Point Edward, a village where the lake empties into the river.

(5) That during the years 1898 onward, there was a very large number of cases of typhoid. It was shown by the evidence of most of the medical practitioners of the town that for every case treated in the hospital there were at least two treated in the homes of the town. This being the case, it will be seen from the following table that there has been during the last fourteen years an almost continuous epidemic of the disease.

Typhoid Fever Cases in the Sarnia General Hospital.

Year.	Total Cases.	Cases from Sarnia Town.
1896	2	2
1897	14	8
1898	20	10
1899	50	24
1900	80	58
1901	89	55
1902	109	73
1903	57	40
1904	25	18
1905	57	46
1906	55	41
1907	37	28
1908	60	49
1909	66	46
1910	60	35
1911	76	59

(6) That the death rate was abnormally large. In the years 1900 to 1911 inclusive, the records of the Registrar General's Department show an average of almost 9 yearly, or a total of 98 deaths. Taking the population at 10,000, this means 90 per 100,000. For 1911 it means 140 per 100,000. A death rate from typhoid of above 20 per 100,000 is considered by sanitarians to be an excessive one. That of Toronto during 1911 was 20 per 100,000. Taking the population of Toronto at 400,000, an equivalent number of cases for that city for 1911 would be 6,000, and the comparative deaths 560! The total typhoid fever death rate for adjacent towns during the last eleven years is—Chatham (12,000), 57; Windsor (18,000), 84; that of Petrolea, which takes its supply from Lake Huron, a distance of about 14 miles, is very low. Last year (1911) there was but one case and *in eleven years but one death.*

As a result of this investigation the new water supply system already referred to is under construction.

Walkerville.

The typhoid rate in this town is intermittent. Some pollution enters the Detroit River, chiefly from navigation, above the intake of this town. At present a fairly satisfactory chlorination of the supply is being done here.

Windsor.

This city takes its water supply from the Detroit River in the ship channel and about half a mile below the nearest Walkerville sewer outlet. Its typhoid rate has always been high. Much difficulty has been experienced in having chlorination properly done in this city. It requires approximately 16 lbs. Hypo-chlorite per million gallons to chlorinate the water at this point. Some deaths are undoubtedly due to the infected water served for drinking purposes on the ferries plying between Windsor and Detroit.

Sandwich.

The typhoid rate in this town is similar to that of Windsor, as would be expected, since their water supply is taken from the Windsor Water Works System.

Amherstburg.

This town is at the lower end of the Detroit River. Its typhoid rate is high, though statistics do not show so high as those of Sandwich or Windsor. The raw water is much worse from bacteriological standard than that of the towns above. This is one of the old fixed population towns. It used to be notorious as a typhoid centre for railroad men. The suggested explanation of the now comparatively low rate is that practically all the inhabitants here at one time or another have had typhoid fever. A good deal of ague at one time existed on this Detroit River littoral. Until recently malaria was blamed for much that must have been typhoid in the earlier days. The water supply of this town is now being chlorinated.

Niagara Falls, Ontario.

The town has taken its water supply from the same source above the Falls for several years. Until 1906 it was comparatively free from typhoid. Since then the typhoid has gone on increasing. Analysis of the town water before 1906 rarely showed infection, since that time infection has been frequent. Power-development has been considerable in the last eight years. Most of the construction work has been below ground. It is possible some of the infection arose from these development works. Many of the people of this town work on the United States side of the River, and vice versa. Niagara Falls, N.Y., has been notorious for years as a typhoid centre. Chippewa Creek, a very sluggish and muddy stream, discharges into the Niagara River a couple of miles above the Niagara Falls, Ont., intake. Twelve miles above its mouth this creek receives the sewage of Welland, a town of seven or eight thousand inhabitants, recently grown from small proportions. The sluggishness and mud content of this water in the twelve miles probably has much to do in minimizing the harmful effect of this pollution. Another explanation that has been suggested for the more frequent pollution of this Niagara Falls water supply is the possible diversion of water from the other side of the river through the greater shore draw-off now going on towards the power plants. Analyses during the summer's investigation on the Niagara River above showed the possibility of Buffalo sewage being at times diverted to the Canadian channel. The behaviour of ice floes during the spring break-up illustrates this possibility very graphically. The Chippewa channel carries approximately five times the volume flowing in the Tonawanda channel. Careful purification of the city's water supply has been frequently advised and should be instituted without delay.

Niagara-on-the-Lake.

The water in the river opposite this town is always polluted, even in so small quantities as one one-hundredth of a cubic centimeter. The statistics show absence of typhoid. Is it that the inhabitants have all become immune? The population here is a fixed one. The old residents get their drinking water supply chiefly from wells and springs. However, the occasional visitor is not as lucky as the regular resident. The militia of this district of Ontario camp here every summer. With them the effect of drinking this town's water was pronounced. Up to three years ago, when no precaution was taken to treat this water, the soldiers suffered much from intestinal trouble and many of them developed typhoid on returning home. During the last three years the men have been supplied with well water, or more recently with disinfected town water. The trouble with intestinal diseases and with typhoid has ceased.

Toronto.

This city has had its population trebled in the last twelve years. Its typhoid rate has never been continuously excessively high. Every material change in its water supply apparatus has resulted in a sympathetic change in the typhoid rate.

Until two years ago all of the city sewage was discharged untreated directly into Toronto Bay or along the lake front west of the Island. Eventually all of it reached the open lake. At the present time the sewage is nearly all being collected by a trunk sewer and delivered at the Morley Avenue Sewage Treatment Plant, where it receives a partial sedimentation and is disinfected with chlorine previous to being discharged into the lake some three miles east of the present water intakes.

Toronto has gone through several outbreaks of typhoid. First, when the intake was located west of the Island in Garrison Common Bay, the rate was intermittently high, reaching at times to even 100. The second period was ushered in when the site of the intake was moved to its present locality, and a wooden conduit laid across the bottom of Toronto Bay to the city. In early years of this period the rate was low, but gradually increased until it reached 55, with exacerbations due to gross accidents to the conduit. In the third period a steel pipe was substituted for the wooden one. The rate fell to the lowest it had been for years, between 17 and 26. Accidents of various kinds happened to this pipe. It was cut by anchors three or four times. Once it rose to the surface. There were in consequence gross infections of the city water with the sewage-polluted bay water, followed by outbreaks of typhoid. Generally the pipe was tight, but the general typhoid rate increased as the population increased. There was no material change when the present tunnel was put in use. Chlorination was started, but was half-heartedly done. The rate was not materially affected. Six months later it was begun seriously with decided improvement in the rate, though the raw water for a year of the time was the worst it had been for years. Then the last period came in with putting into commission of a slow sand filter, which is, however, of too small a capacity to filter all of the city's water; now between the filter, the after chlorination and the present treatment of the bulk of the sewage, practically sterile water is being supplied to Toronto. The typhoid rate for last year—10.5 per 100,000—is the lowest that has been experienced in Toronto for over twenty-five years. The citizens are being well repaid for the expense involved. Money has been voted recently toward the installation of filters sufficient to filter 100,000,000 gallons per day of lake water. It is to be hoped that anxiety with reference to this water supply will soon be removed.

Kingston.

This is another city that has had intake troubles. Their water supply shows intermittent infection. During the greater part of the time the water is pure. Breaks in the inshore end of the conduit have usually resulted in typhoid outbreaks. The investigation last spring showed that Cataraqui Bay, which is always sewage-polluted, intermittently discharged out into the current where the intake is situated. Also, it was shown that with given winds the inshore sewage-polluted water occasionally flowed over the site of the intake. This city is a hospital centre, but the typhoid of the city is out of proportion to that of the county and runs very evenly distributed throughout the year. The rate has for years been generally over 30 per 100,000. The pollution of this city's water supply is chiefly due to the short circuiting of its own sewage—some may arise from navigation.

Brockville.

The typhoid rate in this town has been high for a number of years; the average rate per 100,000 for the last ten years is 47. In 1906 the rate was as high as 109. The lowest rate was 10 per 100,000, in 1910.

The water supply is taken from the St. Lawrence River, about twenty-five miles below the Thousand Islands. Considerable pollution exists in the vicinity of the waterworks intake due to local conditions and to the character of the river water at this point. The pollution is augmented during the navigation season.

From the character of the water supply and from the seasonal distribution of typhoid it is very apparent that the water supply is the major cause of their high typhoid rates. This supply should be filtered to remove gross matter in suspension due to navigation and chlorinated to protect against irregularities in filtration; the typhoid rate should be as low or lower than in 1910, namely 10 per 100,000. The chlorination as practised here during the last two years has not been as successful as one would wish; possibly the dosage is too small.

Cornwall.

The typhoid rate in this town has also been very high for a number of years. The average rate per 100,000 for the last ten years recorded is 59—a very high average rate. In 1906 and 1908 the highest rates were obtained, namely, 85 and 105 per 100,000. The water supply is obtained from the St. Lawrence River, and while the nearest large urban centre, Ogdensburg, is forty-five miles above, pollution has been clearly shown to continue through that distance; this pollution is considerably augmented by navigation during the summer months.

It is reasonable to assume from the character of the water supply, and from the seasonal distribution of typhoid shown on the accompanying sheets, page 31, that the water supply is the major cause of the prevalence of typhoid fever. If the cities above were compelled to sediment and disinfect their sewage, and the navigation companies were to provide for the taking care of sewage from boats, this municipality would have little or no difficulty in controlling typhoid fever. Under existing circumstances it is altogether advisable to instal filters and protect their irregularities by chlorination or other disinfecting measures. No treatment of any kind has been practised there.

John W. S. McCullough.
John A. Amyot.
F. A. Dallyn.

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

The very complete statistics conveniently arranged in tabular form by months for the Province of Ontario have been obtained from the Registrar General's Department of that Province. These statistics show how extensively typhoid fever is scattered throughout the entire province. It is an admitted fact that in any country where the water supplies are unprotected and subject to sewage pollution, and where so much travelling is indulged in, as in Canada and the United States, typhoid fever will never be eradicated except by a concerted movement for the compulsory protection of Municipal Water Supplies.

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

DISTRICT OF ALGOMA

Not including Sault Ste. Marie, Steelton

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	38,195	2	1	1	..	..	..	..	..	2	4	1	2	13
1903		1	..	..	1	..	..	1	1	..	..	..	..	4
1904		..	..	..	1	..	..	..	..	1	2	..	..	4
1905		..	..	..	..	..	..	..	1	3	1	..	..	5
1906		1	2	..	..	..	..	..	2	..	4	3	..	12
1907		3	..	..	..	..	..	2	1	..	1	..	2	9
1908		..	1	1	..	..	..	..	3	2	2	1	2	12
1909		..	..	..	..	1	..	1	..	1	..	..	..	3
1910		1	..	..	1	1	..	..	..	3	2	1	..	9
1911	28,403	..	..	..	..	..	..	..	1	2	1	4	1	9
1912		1	.	..	..	..	..	..	..	..	2	..	1	4
		9	2	4	3	2	..	4	9	14	19	10	8	84

TOWN OF SAULT STE. MARIE

District of Algoma.

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	7,196	..	..	..	2	..	..	2	2	4	4	..	2	16
1903		1	1	1	..	1	..	1	1	..	1	2	2	11
1904		..	1	..	..	..	..	1	..	..	..	..	..	2
1905		..	..	..	..	..	..	2	2	2	2	2	2	12
1906		..	..	..	..	1	..	2	2	3	6	2	..	16
1907		..	1	1	..	..	..	1	1	..	2	..	2	8
1908		..	..	..	..	1	..	..	..	..	2	1	2	6
1909		1	1	..	..	..	..	1	1	2	1	1	..	8
1910		..	1	..	1	..	..	..	2	3	3	4	..	14
1911	10,498	2	..	..	..	2	..	2	10	6	5	4	4	35
1912		3	..	..	..	..	..	1	..	3	2	..	..	9
		7	5	2	3	5	..	13	21	23	28	16	15	138

DISTRICT OF THUNDER BAY

Not including Fort William, Port Arthur

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	5,335	..	1	..	1	..	..	..	1	..	..	..	..	3
1903		2	..	..	..	..	..	..	..	1	1	1	..	5
1904		..	1	..	1	..	..	..	2	1	..	1	1	7
1905		..	..	..	..	..	..	..	..	..	..	..	2	2
1906		..	4	..	..	..	..	1	..	..	..	..	..	5
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	..	2	1	..	..	3
1909		..	..	..	..	..	..	..	..	..	..	..	..	....
1910		..	..	..	1	..	..	..	..	..	..	..	..	1
1911	11,367	..	..	..	..	..	..	..	..	..	..	..	..	....
1912		..	..	..	..	..	..	..	..	..	..	1	1	2
		2	6	..	3	..	..	1	3	4	2	3	4	28

CITY OF PORT ARTHUR

District of Thunder Bay.

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	3,214	1	..	..	..	1	..	..	1	3	..	..	..	6
1903		..	..	..	..	..	..	1	..	1	..	2	..	4
1904		3	..	1	..	2	..	..	1	1	6	..	3	17
1905		1	..	1	..	..	..	..	..	1	..	..	3	6
1906		5	2	4	1	..	1	..	2	6	8	5	1	35
1907		..	..	1	1	..	..	..	3	3	1	1	1	11
1908		..	..	1	..	2	1	1	2	1	4	3	1	16
1909		2	2	..	..	..	1	1	1	5	4	3	1	20
1910		..	..	..	..	..	2	..	4	4	4	7	2	23
1911	11,220	5	..	..	..	..	1	..	2	4	2	1	1	16
1912		..	2	..	..	..	5	2	..	1	3	1	9	23
		17	6	8	2	5	11	5	16	30	32	23	22	177

DISTRICT OF KENORA

Not including Kenora

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
1902		..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	..	..	..	..	..	..	..	..	....
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	..	..	..	..	..	..	..	1	..	2	..	3
1910		..	..	..	..	..	..	..	..	..	..	..	..	....
1911	11,955	..	..	..	..	..	..	..	..	..	..	..	..	....
1912		..	..	..	..	..	..	..	..	..	..	..	..	....
		..	..	..	..	..	..	..	..	1	..	2	..	3

CITY OF FORT WILLIAM

District of Thunder Bay.

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	3,997	..	..	..	..	..	..	3	1	..	..	2	..	6
1903		..	..	..	..	..	..	..	..	1	1	1	1	4
1904		1	..	..	..	2	1	1	..	2	3	3	..	13
1905		1	..	..	..	1	..	..	1	3	..	1	3	10
1906		14	18	35	4	2	2	..	4	6	12	2	..	99
1907		..	..	..	..	2	..	..	3	2	..	..	1	8
1908		..	..	..	..	..	..	..	2	3	5	7	1	18
1909		1	..	..	..	..	1	1	1	6	4	3	1	18
1910		..	..	..	2	1	..	..	2	2	2	5	1	15
1911	16,499	..	..	..	..	2	..	..	3	1	..	..	1	7
1912		1	..	..	1	1	..	1	..	2	..	..	1	7
		18	18	35	7	11	4	6	17	28	27	24	10	205

DISTRICT OF RAINY RIVER

Not including Kenora to 1908

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	10,839	..	..	..	..	..	..	..	..	..	1	..	3	4
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	1	1	..	..	2
1905		2	..	..	..	..	..	..	..	..	..	..	1	3
1906		1	..	..	1	..	..	..	2	1	3	..	..	8
1907		1	..	1	..	1	..	..	..	3	1	..	..	7
1908		..	..	..	..	..	..	1	..	..	1	2	..	4
1909		..	..	..	1	..	..	..	..	..	..	..	..	1
1910		..	..	..	..	..	..	..	1	..	2	2	2	7
1911	10,050	1	..	..	..	1	..	..	2	1	..	1	1	7
1912		1	..	1	..	..	..	..	..	..	..	..	..	2
		6	..	2	2	2	..	1	5	6	9	5	7	45

TOWN OF KENORA

District of Kenora.

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	5,202	..	..	..	..	1	1	..	..	..	1	..	1	4
1903		..	..	..	..	..	..	..	1	..	1	..	..	2
1904		1	1	..	..	..	..	..	..	1	2	2	..	7
1905		..	..	..	..	..	..	..	1	1	..	1	2	5
1906		1	..	1	1	2	2	..	2	..	7	6	5	27
1907		4	..	2	1	2	1	..	5	5	7	3	7	37
1908		..	2	1	..	1	..	1	4	9	29	13	4	64
1909		..	1	..	..	..	..	..	1	4	1	1	1	9
1910		..	..	..	..	..	..	..	1	..	1	3	..	5
1911	6,158	..	..	..	..	..	..	1	..	..	..	..	..	1
1912		..	1	..	..	..	..	1	..	..	..	..	..	2
		6	5	4	2	6	4	3	15	20	49	29	20	163

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months. 1902-1912, inclusive.

COUNTY OF BRANT

Not including Brantford

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	21,512	2	..	1	..	..	1	..	..	1	..	..	..	5
1903		1	..	..	..	1	..	..	..	1	..	..	1	4
1904		1	1	..	..	..	..	..	..	..	1	..	..	3
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	..	..	1	..	..	1	1	..	3
1907		..	..	..	..	..	..	..	..	1	2	..	..	3
1908		..	..	1	..	..	..	..	..	..	1	1	..	3
1909		..	..	..	2	..	..	..	..	..	..	..	..	2
1910		..	..	..	..	..	..	2	2	..	..	..	..	4
1911	22,744	..	..	..	..	..	1	..	..	1	..	1	1	4
1912		1	..	..	1	..	1	..	1	2	..	..	..	6
		5	1	2	3	1	3	3	3	6	5	3	2	37

CITY OF BRANTFORD

County of Brant

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	16,619	..	..	..	..	..	1	..	..	2	1	1	1	6
1903		..	..	..	..	1	..	..	..	1	2	2	..	6
1904		1	1	..	..	..	..	1	3	1	..	2	..	9
1905		..	..	..	..	..	..	..	1	..	1	..	..	2
1906		..	..	..	..	..	1	..	..	2	1	5	1	10
1907		1	..	..	..	..	..	..	1	1	2	..	..	5
1908		..	..	..	2	..	..	..	..	2	3	4	..	11
1909		1	..	..	..	..	..	..	..	2	1	1	..	5
1910		..	..	..	1	..	..	..	4	5	3	1	1	15
1911	23,132	1	..	1	..	..	..	1	3	4	2	4	1	17
1912		1	..	..	..	..	..	..	..	..	2	1	..	4
		5	1	1	3	1	2	2	12	20	18	21	4	90

COUNTY OF CARLETON

Not including Ottawa

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	36,997	1	1	..	..	..	1	2	..	..	..	..	..	5
1903		..	..	..	..	..	1	..	..	..	..	..	..	1
1904		1	..	..	..	..	..	..	1	1	..	..	2	5
1905		..	..	..	..	..	..	..	1	1	..	2	..	4
1906		3	..	..	..	..	..	1	..	2	2	1	..	9
1907		1	1	..	..	..	..	..	1	..	..	..	..	3
1908		..	..	..	..	..	1	..	..	1	..	..	..	2
1909		1	1	..	..	..	1	..	..	..	..	..	..	3
1910		..	..	..	1	..	..	..	1	1	..	..	..	3
1911	14,537	..	1	..	..	1	..	..	..	..	..	..	..	2
1912		..	..	..	..	..	..	..	..	2	..	1	..	3
		7	4	..	1	1	4	3	4	8	2	4	2	40

CITY OF OTTAWA

County of Carleton

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	59,928	1	2	1	2	..	4	1	1	4	1	2	..	19
1903		..	1	..	1	..	..	..	1	2	..	1	..	6
1904		..	..	..	1	..	..	..	1	3	4	2	2	13
1905		1	2	1	..	2	2	1	1	1	1	..	2	14
1906		1	..	2	1	1	1	1	4	2	5	4	3	25
1907		7	3	3	3	2	1	..	3	4	4	2	6	38
1908		..	..	..	..	1	1	2	1	1	7	8	4	25
1909		2	2	1	1	..	1	1	..	5	3	1	3	20
1910		1	3	2	1	..	1	1	2	3	6	3	1	24
1911	87,062	8	29	23	12	2	2	1	..	2	5	2	1	87
1912		..	..	..	1	1	..	6	52	12	19	4	3	98
		21	42	33	23	9	13	14	66	39	55	29	25	369

COUNTY OF DUFFERIN

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	21,036	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	1	..	..	..	..	1
1904		..	..	..	..	2	..	..	..	..	..	1	..	3
1905		..	..	..	..	1	..	..	1	..	..	..	..	2
1906		1	..	7	2	..	1	1	..	..	..	..	1	13
1907		..	..	1	..	..	..	..	..	..	..	..	..	1
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	1	..	..	..	..	..	..	..	..	..	..	1
1910		..	..	..	..	..	1	..	..	1	..	..	..	2
1911	17,740	..	..	..	..	..	1	..	..	..	..	..	..	1
1912		..	..	..	..	..	..	..	..	..	..	..	..	....
		1	1	8	2	3	3	1	2	1	..	1	1	24

COUNTIES OF NORTHUMBERLAND AND DURHAM

Not including Cobourg, Port Hope

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	53,588	..	..	..	1	1	..	..	1	3	1	3	..	10
1903		..	..	1	1	..	..	1	..	..	..	..	2	5
1904		2	..	..	..	1	..	..	1	..	1	1	..	6
1905		..	..	1	..	..	..	1	..	..	..	1	2	5
1906		..	1	1	..	..	..	..	..	..	..	2	3	7
1907		..	2	..	..	..	1	1	1	1	..	1	2	[illegible]
1908		..	..	..	..	..	..	..	..	3	2	2	2	9
1909		1	1	1	2	1	..	..	2	1	..	1	1	11
1910		..	..	..	2	1	..	..	1	1	6	4	2	17
1911	49,161	1	1	..	..	1	1	..	..	..	2	1	1	8
1912		..	2	..	2	..	..	..	..	..	..	..	..	4
		4	7	4	8	5	2	3	6	9	12	16	15	91

TOWN OF COBOURG

County of Northumberland

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	4,239	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	1	..	..	..	..	..	..	..	1	2
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	..	..	..	..	..	..	..	..	..	..	..	....
1910		1	..	..	..	..	..	..	..	1	..	..	..	2
1911	5,047	..	..	..	..	..	..	..	..	2	1	..	1	4
1912	....	..	..	..	1	..	..	..	..	..	..	..	..	1
		1	..	..	2	..	..	..	..	3	1	..	2	9

TOWN OF PORT HOPE

County of Durham

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	4,222	..	1	..	..	..	1	..	..	..	..	..	..	2
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	1	..	..	..	..	..	..	..	..	..	..	1
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		1	..	..	..	..	..	..	..	..	2	..	..	3
1907		1	..	..	..	..	..	..	..	..	..	..	..	1
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	..	..	..	..	1	1	..	..	1	1	..	4
1910		..	..	..	..	..	..	..	..	..	..	..	..	....
1911	5,092	..	..	..	..	..	..	..	..	..	1	1	1	3
1912		..	..	2	..	..	..	..	..	1	..	1	..	4
		2	2	2	..	..	2	1	..	1	4	3	1	18

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

COUNTY OF ELGIN

Not including St. Thomas

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	32,101	..	..	..	..	..	..	1	1	..	..	..	2	4
1903		1	1	..	..	..	..	..	1	..	..	1	1	5
1904		..	..	..	..	..	..	..	..	1	1	..	..	2
1905		..	..	..	..	..	..	..	1	..	1	..	..	2
1906		..	..	..	..	2	1	..	1	1	1	3	..	9
1907		1	..	..	..	..	..	..	..	1	..	..	1	3
1908		..	..	..	..	..	3	..	1	..	1	1	..	6
1909		..	..	1	..	..	..	..	1	1	..	..	1	4
1910		..	..	1	..	..	..	..	1	..	..	1	..	3
1911	30,528	..	..	..	..	..	..	1	..	..	..	..	..	1
1912		..	1	..	1	..	..	..	1	..	..	..	..	3
		2	2	2	1	2	4	2	8	4	4	6	5	42

COUNTY OF ESSEX

Not including Windsor

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	46,363	1	..	..	..	..	..	..	1	1	1	1	..	5
1903		1	1	..	..	1	..	1	1	1	1	2	2	11
1904		1	1	3	..	1	..	..	2	1	2	..	2	13
1905		..	..	1	..	..	1	1	1	3	..	1	2	10
1906		1	2	..	2	..	1	..	1	..	3	3	1	14
1907		2	2	..	..	1	..	..	..	2	..	..	1	8
1908		1	2	..	1	1	1	1	..	1	1	1	3	13
1909		..	2	2	3	1	2	..	3	..	..	3	..	16
1910		..	..	1	..	..	..	..	..	5	1	3	..	10
1911	49,718	4	1	..	..	1	1	..	..	..	1	2	3	13
1912		1	..	..	1	..	..	..	1	5	..	6	4	18
		12	11	7	7	6	6	3	10	19	10	22	18	131

CITY OF ST. THOMAS

County of Elgin

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	11,485	..	..	..	..	..	..	1	..	..	1	..	..	2
1903		..	..	..	..	..	..	..	1	..	..	..	..	1
1904		..	..	..	..	..	..	..	..	1	1	..	2	4
1905		..	..	..	..	..	1	..	..	..	..	..	..	1
1906		..	..	1	..	..	..	..	..	1	..	3	..	5
1907		1	..	..	1	..	..	..	..	1	..	..	..	3
1908		..	..	..	..	..	..	..	1	..	3	2	1	7
1909		..	..	..	1	..	..	..	1	1	1	..	1	5
1910		..	..	..	..	1	1	..	..	..	1	..	..	3
1911	14,054	..	..	..	..	..	1	1	..	..	1	..	..	3
1912		..	..	..	..	..	..	..	..	..	3	..	..	3
		1	..	1	2	1	3	2	3	4	11	5	4	37

CITY OF WINDSOR

County of Essex

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	12,153	..	..	1	..	1	..	..	..	1	..	..	2	5
1903		..	2	1	..	..	..	..	1	..	..	..	..	4
1904		1	1	1	1	..	..	..	2	..	..	2	..	8
1905		..	2	..	..	..	..	..	..	..	1	2	1	6
1906		1	..	1	..	..	..	1	..	..	..	1	2	6
1907		1	1	1	1	3	1	..	..	1	1	1	1	12
1908		..	..	1	1	1	..	..	..	3	1	3	..	10
1909		..	..	..	..	..	..	..	..	5	3	1	..	9
1910		..	..	..	..	..	..	3	..	2	1	1	1	8
1911	17,829	1	..	..	..	..	2	..	..	2	..	1	..	6
1912		1	1	..	2	..	1	..	..	..	..	2	..	7
		5	7	6	5	5	4	4	3	14	7	14	7	81

COUNTY OF FRONTENAC

Not including Kingston

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	26,843	..	..	1	..	..	1	1	..	1	..	..	..	4
1903		..	1	1	1	..	1	..	1	1	1	..	..	7
1904		1	..	..	1	1	..	..	1	..	..	1	..	5
1905		1	..	..	..	2	..	..	..	..	1	..	..	4
1906		..	..	..	..	..	..	..	..	2	1	2	2	7
1907		..	..	1	..	..	..	..	..	1	..	..	..	2
1908		..	..	..	..	..	..	..	..	..	..	3	..	3
1909		..	..	1	..	..	..	..	..	1	2	..	..	4
1910		..	..	..	..	1	2	..	1	1	..	1	..	6
1911	23,730	..	..	1	..	..	1	..	..	..	2	..	..	4
1912		..	..	..	..	..	..	..	..	..	..	..	1	1
		2	1	5	2	4	5	1	3	7	7	7	3	47

COUNTY OF GREY

Not including Owen Sound

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	60,814	..	..	1	1	..	..	..	..	..	..	..	1	3
1903		..	1	..	1	..	..	1	..	2	1	..	..	6
1904		..	..	..	..	..	1	..	1	1	1	..	1	5
1905		1	..	1	..	1	..	..	..	..	3	2	3	11
1906		..	1	..	..	2	..	..	1	1	1	..	2	8
1907		..	..	..	..	..	1	..	..	..	..	1	..	2
1908		..	..	..	..	..	..	1	2	..	2	..	..	5
1909		..	..	..	..	..	..	..	..	1	2	1	..	4
1910		..	..	..	1	1	..	..	..	..	1	..	1	4
1911	53,333	..	..	..	..	..	..	..	1	..	..	1	..	2
1912		..	..	..	1	..	..	..	..	..	..	..	..	1
		1	2	2	4	4	2	2	5	5	11	5	8	51

CITY OF KINGSTON

County of Frontenac

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	17,691	..	..	..	..	..	..	..	..	1	..	..	..	1
1903		2	1	10	1	..	1	1	..	..	..	..	2	18
1904		..	..	..	..	..	..	1	2	..	..	..	1	4
1905		..	1	..	1	..	2	..	1	..	1	..	2	7
1906		1	..	1	2	..	..	1	..	..	1	..	1	7
1907		..	..	..	..	..	..	1	..	2	..	1	1	5
1908		..	..	..	..	..	..	..	..	1	..	3	2	6
1909		..	..	..	..	1	1	..	..	1	..	1	2	6
1910		3	1	1	1	..	..	2	..	1	..	4	3	15
1911	18,874	1	..	2	..	..	..	..	..	1	..	1	..	5
1912		..	1	1	1	..	..	1	1	1	..	..	..	6
		7	4	15	4	3	4	7	4	8	2	10	14	80

TOWN OF OWEN SOUND

County of Grey

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	8,776	..	..	..	..	..	..	1	..	1	..	..	..	2
1903		..	..	..	..	..	..	..	..	..	..	..	1	1
1904		..	..	..	..	..	..	..	..	..	1	1	1	3
1905		..	..	2	..	..	..	..	2	..	..	..	1	5
1906		..	..	..	..	..	..	..	1	1	4	1	..	7
1907		..	..	..	..	..	..	..	..	1	1	..	1	3
1908		..	..	..	..	..	..	..	1	..	1	..	..	2
1909		..	..	..	..	..	..	..	..	1	2	3	..	6
1910		..	..	..	..	..	..	..	..	..	..	2	..	2
1911	12,558	..	1	1	..	..	..	..	..	..	..	..	..	2
1912		..	..	..	..	..	..	..	..	..	1	..	..	1
		..	1	3	..	..	..	1	4	4	10	7	4	34

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

COUNTY OF HALDIMAND

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	21,233	..	..	..	..	1	..	..	..	1	1	..	..	3
1903		..	..	..	..	..	..	1	1	..	..	2	..	5
1904		..	..	..	..	..	..	..	1	..	..	..	..	1
1905		..	..	..	1	1	..	..	..	..	..	1	..	3
1906		..	1	..	..	1	..	..	..	2	6	..	1	11
1907		..	..	1	..	..	..	..	..	..	..	..	..	1
1908		1	..	..	..	..	..	..	..	2	1	..	..	4
1909		1	..	1	..	..	..	..	..	..	2	..	..	4
1910		1	3	2	..	..	..	..	..	..	..	1	..	7
1911	21,562	..	1	..	..	..	..	..	..	..	..	..	..	1
1912		1	..	1	..	..	..	..	..	..	1	..	..	3
		5	5	5	1	3	..	1	2	5	11	4	1	43

COUNTY OF HASTINGS
Not including Belleville

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	50,174	1	..	..	..	1	..	..	..	..	..	1	..	3
1903		..	..	..	..	..	..	1	..	..	1	1	..	3
1904		1	..	..	..	1	..	..	..	1	..	..	..	3
1905		..	..	..	..	1	..	..	..	..	1	1	1	4
1906		1	1	..	..	..	..	..	..	3	2	..	1	8
1707		..	..	..	3	1	..	..	..	..	..	1	1	6
1908		..	1	..	..	..	..	..	..	1	1	3	1	7
1909		1	1	2	..	..	..	..	..	..	2	2	..	8
1910		..	..	1	..	..	..	..	1	1	2	..	1	6
1911	45,927	..	..	..	1	1	..	2	..	2	1	..	..	7
1912		..	1	..	1	..	..	..	..	1	..	1	..	4
		4	4	3	5	5	..	3	1	9	10	10	5	59

COUNTY OF HALIBURTON

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	6,559	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	1	1	..	..	1	..	..	..	..	..	3
1904		..	..	..	..	1	..	..	..	1	..	..	..	2
1905		..	..	..	..	..	..	..	..	..	1	..	..	1
1906		..	..	..	..	..	..	..	..	..	..	..	..	....
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	3	..	..	..	..	..	..	..	..	..	..	3
1909		..	..	..	..	..	..	..	..	..	..	..	..	....
1910		..	..	..	..	..	..	..	..	..	..	..	..	....
1911	5,309	..	..	..	..	..	..	..	..	..	..	..	..	....
1912		..	..	..	..	..	..	..	..	1	..	..	..	1
		..	3	1	1	1	..	1	..	2	1	..	..	10

CITY OF BELLEVILLE
County of Hastings

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	9,117	..	1	..	..	..	..	..	..	1	1	2	..	5
1903		..	..	..	1	..	1	..	..	..	1	..	..	3
1904		..	..	..	..	1	..	..	..	..	..	..	..	1
1905		..	..	..	..	..	..	..	1	..	1	..	..	2
1906		..	..	..	..	..	..	..	..	2	2	1	3	8
1907		2	2	..	..	1	1	..	..	..	1	1	..	8
1908		..	..	..	..	..	..	1	1	..	2	2	1	7
1909		..	..	..	..	..	1	..	1	1	1	..	..	4
1910		..	..	..	..	1	..	..	..	1	1	2	..	5
1911	9,876	..	..	..	..	..	..	..	..	..	..	2	..	2
1912		2	..	1	..	..	..	..	..	..	1	..	..	4
		4	3	1	1	3	3	1	3	5	11	10	4	49

COUNTY OF HALTON

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	19,545	..	..	..	..	..	..	..	..	..	..	..	1	1
1903		..	..	2	..	..	..	..	..	..	..	1	..	3
1904		..	2	..	..	..	..	..	1	..	..	..	..	3
1905		..	..	..	..	..	..	..	..	..	2	1	1	4
1906		..	..	..	..	..	..	..	..	..	1	..	..	1
1907		..	..	..	..	..	..	..	..	..	..	..	1	1
1908		..	1	..	..	..	..	..	1	..	1	..	..	3
1909		..	..	1	..	..	..	..	..	1	1	..	..	3
1910		..	1	..	..	..	..	..	..	1	1	1	..	4
1911	22,208	..	..	..	..	..	..	..	..	1	1	1	..	3
1912		..	1	..	1	1	1	..	..	..	..	..	..	4
		..	5	3	1	1	1	..	2	3	7	4	3	30

COUNTY OF KENT
Not including Chatham

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	48,354	..	2	..	1	..	..	..	1	1	3	..	..	8
1903		..	..	1	2	..	..	..	..	1	1	1	..	6
1904		1	..	..	..	..	..	..	..	1	1	2	4	9
1905		..	..	..	1	..	2	..	..	4	1	2	..	10
1906		..	1	..	1	..	..	..	1	1	5	..	1	10
1907		1	..	..	..	..	..	..	1	1	..	..	..	3
1908		..	1	..	1	..	..	..	1	..	2	1	..	6
1909		..	1	..	..	..	1	..	..	..	1	..	..	3
1910		..	..	..	..	..	1	1	2	..	2	..	..	6
1911	45,225	..	..	..	1	..	..	..	..	..	..	..	..	1
1912		..	..	..	1	1	..	..	1	..	1	..	1	5
		2	5	1	8	1	4	1	7	9	17	6	6	67

COUNTY OF HURON

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	61,820	..	..	..	1	..	..	1	1	..	1	1	1	6
1903		..	..	2	1	2	..	..	1	1	..	2	..	9
1904		..	..	..	..	3	..	..	..	2	1	1	..	7
1905		—	..	1	..	..	..	..	..	..	..	1	..	2
1906		..	..	..	..	..	3	2	1	3	1	4	..	14
1907		2	..	2	..	..	..	..	..	1	..	2	3	10
1908		..	..	..	..	..	1	4	2	2	2	1	1	13
1909		..	1	1	..	..	..	1	..	2	5	1	1	12
1910		2	1	..	..	..	..	..	..	1	..	2	..	6
1911	52,983	..	..	2	1	..	..	..	2	2	1	1	..	9
1912		..	..	..	..	..	..	..	1	1	..	..	..	2
		4	2	8	3	5	4	8	8	15	11	16	6	90

CITY OF CHATHAM
County of Kent

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	9,068	..	..	..	1	..	..	..	..	1	1	1	..	4
1903		..	..	..	..	..	1	..	..	..	..	..	1	2
1904		..	..	..	..	2	..	..	1	..	1	2	1	7
1905		..	..	1	..	..	..	..	..	..	2	..	..	3
1906		1	..	..	..	..	..	..	..	1	1	2	..	5
1907		..	..	..	..	1	1	..	1	1	1	..	..	5
1908		..	..	..	..	1	1	..	..	2	..	1	..	5
1909		1	..	..	1	..	..	2	1	..	2	..	..	7
1910		..	..	..	1	..	..	..	..	2	1	..	..	4
1911	10,770	..	..	..	..	..	..	..	..	..	1	3	..	4
1912		1	1	..	1	..	..	..	..	2	..	..	..	5
		3	1	1	4	4	3	2	3	9	10	9	2	51

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

COUNTY OF LAMBTON
Not including Sarnia

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	48,466	..	1	1	..	1	..	..	1	1	2	2	2	11
1903		..	..	1	..	1	..	..	3	..	1	2	..	8
1904		..	..	..	1	1	1	..	2	..	1	..	1	7
1905		..	1	..	..	..	1	..	..	1	2	..	1	6
1906		..	1	1	..	..	..	..	..	2	3	3	3	13
1907		1	..	2	2	..	..	2	1	..	2	1	..	11
1908		..	2	1	1	..	1	1	1	1	..	1	2	11
1909		1	1	..	..	..	2	1	..	1	..	1	2	9
1910		..	..	..	..	..	..	..	..	1	1	..	1	3
1911	41,585	..	..	2	..	..	..	..	1	1	1	1	1	7
1912		..	..	..	1	1	..	..	..	..	..	..	..	2
		2	6	8	5	4	5	4	9	8	13	11	13	88

COUNTY OF LANARK
Not including Smith's Falls

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	32,087	..	..	..	..	..	..	..	..	1	2	..	2	5
1903		..	1	1	1	..	1	..	..	1	..	1	..	6
1904		1	..	..	..	..	..	..	1	..	..	..	..	2
1905		1	..	..	..	..	1	..	..	..	..	..	..	2
1906		..	..	..	1	1	..	..	..	3	2	..	..	7
1907		2	..	..	..	..	1	..	1	..	..	..	2	6
1908		..	..	1	..	..	..	1	..	..	..	1	..	3
1909		1	..	..	2	1	2	..	2	1	1	..	3	13
1910		..	2	..	..	..	..	..	..	2	..	1	..	5
1911	18,005	..	1	..	..	..	..	1	1	..	1	..	1	5
1912		..	..	..	..	..	..	..	1	2	..	..	..	3
		5	4	2	4	2	5	2	6	10	6	3	8	57

TOWN OF SARNIA
County of Lambton

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	8,176	1	..	1	1	..	..	..	..	..	2	6	2	13
1903		..	1	..	..	..	..	..	3	4	3	3	..	14
1904		..	..	..	..	..	..	..	1	..	1	1	..	3
1905		..	..	1	..	..	1	..	..	..	..	..	1	3
1906		1	..	..	..	..	..	..	1	..	3	..	..	5
1907		..	..	..	..	1	1	1	..	3	2	..	..	8
1908		1	..	..	..	1	..	..	2	3	2	..	2	11
1909		1	..	..	..	..	..	1	2	1	1	1	1	8
1910		..	1	1	..	1	1	1	3	..	2	..	..	10
1911	9,947	1	1	2	..	..	1	1	2	..	1	2	3	14
1912		2	..	4	1	1	..	2	1	..	..	..	3	14
		7	3	9	2	4	4	6	15	11	17	13	12	103

TOWN OF SMITH'S FALLS
County of Lanark

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	5,145	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	1	..	..	..	..	..	..	..	2	..	..	3
1907		1	..	..	..	..	..	..	..	..	..	..	..	1
1908		..	..	1	..	..	..	..	..	2	..	..	..	3
1909		1	..	..	..	..	..	1	..	..	..	3	..	5
1910		1	..	..	..	..	..	..	..	1	1	..	..	3
1911	6,370	..	..	..	..	..	..	..	..	1	..	..	..	1
1912		..	..	1	..	1	..	..	..	1	..	..	..	3
		3	1	2	..	1	..	1	..	5	3	3	..	19

COUNTY OF LEEDS AND GRENVILLE
Not including Brockville

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	50,056	..	..	1	..	2	..	..	2	..	..	..	..	5
1903		..	..	..	2	1	..	3	1	..	..	..	..	8
1904		1	..	1	..	..	1	..	2	1	..	1	..	7
1905		..	..	..	1	1	..	..	1	3	..	1	..	7
1906		1	..	..	..	..	1	1	..	..	2	1	..	6
1907		..	1	1	2	..	..	..	2	..	2	1	..	9
1908		..	..	1	3	..	..	..	..	..	1	1	..	6
1909		..	1	..	1	..	..	..	..	..	4	..	..	6
1910		..	..	..	..	..	3	1	..	..	..	1	1	6
1911	44,951	1	..	..	..	..	..	..	..	..	2	..	..	3
1912		..	..	..	..	2	..	1	..	..	..	2	..	5
		3	2	4	9	6	5	6	8	5	11	8	1	68

COUNTIES OF LENNOX AND ADDINGTON

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	23,346	..	..	..	..	..	..	..	..	1	..	..	..	1
1903		1	..	..	..	1	..	..	1	..	1	..	..	4
1904		..	1	..	..	..	..	..	1	..	..	..	..	2
1905		..	..	1	..	..	..	1	2	..	..	..	..	4
1906		..	..	..	..	1	..	..	..	1	3	..	..	5
1907		..	..	..	..	..	..	..	..	2	..	..	..	2
1908		1	..	..	..	..	..	..	..	..	2	4	..	7
1909		..	..	..	..	..	..	..	1	..	..	..	..	1
1910		..	..	..	1	..	..	1	..	..	1	..	..	3
1911	20,386	1	1	..	..	1	..	..	..	..	..	1	..	4
1912		..	..	..	..	1	..	..	..	..	..	..	..	1
		3	2	1	1	4	..	2	4	5	7	5	..	34

TOWN OF BROCKVILLE
County of Leeds

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	8,940	..	..	..	..	..	1	..	..	2	..	..	1	4
1903		2	..	..	..	1	1	..	..	..	1	..	1	6
1904		..	1	2	1	1	..	..	..	1	..	..	..	6
1905		..	..	..	..	..	..	1	1	..	..	..	..	2
1906		..	..	..	..	1	..	1	3	2	3	..	..	10
1907		1	1	..	..	..	..	..	..	..	..	..	..	2
1908		..	..	..	..	..	1	..	1	..	1	..	1	4
1909		..	..	..	..	..	..	..	..	1	1	1	..	3
1910		..	..	..	..	1	..	..	..	..	..	..	..	1
1911	9,347	..	..	1	1	1	..	..	..	..	..	1	..	4
1912		..	..	..	1	..	..	1	..	..	2	1	1	6
		2	2	4	3	5	3	3	5	6	8	3	4	48

DISTRICT OF MANITOULIN.

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
1902		..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	..	..	..	..	..	..	..	..	....
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	..	..	..	..	..	..	..	..	..	..	..	....
1910		..	..	..	..	..	..	..	..	..	..	1	1	2
1911		3	..	..	..	..	1	..	..	..	1	..	..	5
1912		..	..	..	..	..	..	..	..	..	..	..	..	....
		3	..	..	..	..	1	..	..	..	1	1	1	7

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

COUNTY OF LINCOLN

Not including St. Catharines

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	20,606	1	..	..	..	..	..	..	..	1	2	..	..	4
1903		2	..	2	..	..	..	..	..	..	1	..	..	5
1904		1	..	1	..	1	..	..	..	..	1	..	1	5
1905		..	1	..	..	1	1	..	..	1	..	2	2	8
1906		..	1	..	..	..	..	..	..	..	2	..	1	4
1907		..	..	..	1	..	..	1	..	..	..	..	1	3
1908		..	1	..	..	..	..	..	..	..	..	..	..	1
1909		..	..	..	..	..	..	..	..	..	1	1	..	2
1910		..	..	1	..	..	1	..	..	..	2	2	..	6
1911	22,945	..	..	..	..	..	..	..	..	..	..	..	..	....
1912		..	..	..	..	..	..	..	1	..	2	..	..	3
		4	3	4	1	2	2	1	1	2	11	5	5	41

CITY OF ST. CATHARINES

County of Lincoln

	01													
1902	9,946	..	1	1	..	..	..	..	..	2	1	..	..	5
1903		1	..	..	1	..	1	..	..	1	..	1	..	5
1904		1	1	1	..	1	1	1	..	..	1	..	1	8
1905		..	..	..	1	..	..	1	..	..	1	..	..	3
1906		1	..	..	..	..	..	..	1	..	..	1	..	3
1907		1	..	..	..	..	..	..	..	1	1	..	..	3
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	..	..	..	..	..	2	..	1	..	..	..	3
1910		..	..	..	..	..	..	..	1	1	1	..	..	3
1911	12,484	1	2	..	1	..	1	1	..	1	..	2	..	9
1912		1	..	..	..	..	..	..	..	..	1	1	..	3
		6	4	2	3	1	3	5	2	7	6	5	1	45

COUNTY OF MIDDLESEX

Not including London

	01													
1902	54,721	..	..	1	..	..	..	..	1	1	1	..	..	4
1903		1	..	..	..	1	..	..	..	..	..	..	1	3
1904		1	..	1	..	..	..	..	2	1	..	..	..	5
1905		1	1	..	1	..	..	..	..	2	1	1	..	7
1906		..	1	1	..	..	1	..	..	1	2	2	1	9
1907		3	1	1	..	..	..	..	..	1	1	..	..	7
1908		..	..	..	1	..	..	..	1	1	..	2	..	5
1909		..	1	2	1	..	..	..	..	1	..	..	..	5
1910		..	..	1	..	..	..	..	..	..	1	1	..	3
1911	50,765	2	1	..	..	1	..	2	..	..	..	..	..	6
1912		..	..	1	..	..	..	2	..	..	..	..	..	3
		8	5	8	3	2	1	4	4	8	6	6	2	57

CITY OF LONDON

County of Middlesex

	01													
1902	37,908	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		1	..	..	..	..	1	..	..	..	1	..	..	3
1904		1	1	..	1	..	..	..	4	6	1	1	2	17
1905		1	..	..	..	1	..	..	3	1	1	2	1	10
1906		1	..	..	..	..	..	1	2	2	5	2	2	15
1907		2	1	..	..	..	..	..	..	..	..	..	..	3
1908		..	..	..	..	..	..	..	2	2	2	..	..	6
1909		..	..	..	..	..	..	..	..	..	1	2	..	3
1910		..	..	..	..	..	..	..	..	..	..	1	1	2
1911	46,300	1	..	..	..	..	..	..	2	1	2	2	..	8
1912		1	1	..	..	..	..	..	1	..	1	1	..	5
		8	3	..	1	1	1	1	14	12	14	11	6	72

DISTRICT OF NIPISSING

Not including North Bay and Cobalt

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
1902		1	..	1	..	2	..	..	..	2	2	..	3	11
1903		..	..	..	1	4	1	1	..	1	2	..	4	14
1904		1	..	..	..	2	4	..	..	3	7	2	2	21
1905		1	1	..	..	..	1	..	1	5	6	9	2	26
1906		2	5	4	..	3	1	3	6	13	17	11	4	69
1907		3	2	2	1	..	1	3	2	7	7	6	3	37
1908		1	..	..	..	..	2	..	2	6	4	4	4	23
1909		3	..	5	1	6	2	2	..	13	25	6	..	63
1910		6	3	..	4	1	1	..	..	8	5	1	3	32
1911	45,678	..	..	1	..	2	..	..	..	5	3	1	..	12
1912		5	2	..	1	..	..	1	4	4	2	..	..	19
		23	13	13	8	20	13	10	15	67	80	40	25	327

TOWN OF COBALT

District of Nipissing.

1902		..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	..	..	..	..	..	..	..	..	....
1907		..	..	..	..	..	..	..	..	1	..	2	..	3
1908		..	..	..	..	..	..	..	..	..	..	3	2	5
1909		3	..	..	2	1	..	2	2	14	23	14	5	66
1910		3	1	..	..	..	..	..	4	2	6	1	..	17
1911	5,638	..	..	..	..	..	..	..	..	2	..	1	..	3
1912		..	..	..	..	..	..	..	..	1	1	1	..	3
		6	1	..	2	1	..	2	6	20	30	22	7	97

TOWN OF NORTH BAY

District of Nipissing.

	01													
1902	2,530	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	2	..	..	2
1904		..	..	..	..	1	..	1	3	1	..	1	..	7
1905		..	..	..	..	..	..	..	2	..	..	4	5	11
1906		2	..	..	..	..	1	2	1	1	4	..	2	13
1907		..	..	..	..	1	..	..	..	2	..	..	..	3
1908		1	..	..	1	..	1	..	1	..	2	..	1	7
1909		..	..	..	..	..	..	..	3	1	2	1	..	7
1910		1	..	..	..	..	..	..	2	1	..	2	1	7
1911	7,737	..	..	..	..	..	..	..	1	1	3	2	..	7
1912		..	..	..	..	1	..	..	..	..	..	2	..	3
		4	..	..	1	3	2	3	13	7	13	12	9	67

DISTRICT OF MUSKOKA.

	01													
1902	20,971	1	1	1	..	..	..	1	1	2	1	..	..	8
1903		..	..	..	..	..	..	..	..	1	2	..	..	3
1904		..	..	..	..	..	..	..	1	2	..	1	..	4
1905		..	2	..	..	..	..	..	1	1	1	2	..	7
1906		..	..	..	..	..	..	..	..	..	..	1	..	1
1907		..	..	..	..	..	..	..	1	..	..	..	1	2
1908		..	..	..	..	..	..	..	..	2	..	..	..	2
1909		..	..	..	..	..	..	..	1	3	2	1	..	7
1910		..	..	..	1	..	..	..	..	1	..	1	1	4
1911	21,233	..	..	..	..	..	..	..	..	1	..	1	1	3
1912		..	..	1	..	..	..	..	..	..	..	..	..	1
		1	3	2	1	..	..	1	5	13	6	7	3	42

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

COUNTY OF ONTARIO

Not including Oshawa

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	35,988	..	..	..	..	..	..	..	1	5	2	1	..	9
1903		1	1	..	..	..	..	..	1	..	..	1	..	4
1904		..	..	..	1	..	..	1	1	1	1	3	..	8
1905		..	..	..	..	..	..		..	..	..	2	2	4
1906		..	1	..	..	..	..	..	..	..	1	4	2	8
1907		1	1	..	..	..	..	..	..	..	1	1	..	4
1908		..	..	..	..	1	..	1	1	..	1	3	..	7
1909		1	..	1	1	..	1	..	1	..	3	1	1	10
1910		4	..	..	..	..	..	..	1	1	1	..	1	8
1911	33,570	..	..	..	..	..	1		1	..	1	..	..	3
1912		..	..	..	..	2	..		2	..	1	..	..	5
		7	3	1	2	3	2	2	9	7	12	16	6	70

TOWN OF OSHAWA

County of Ontario

	01													
1902	4,420	1	..	..	..	..	..	..	..	1	..	..	..	2
1903		1	1	..	..	..	..	..	..	..	1	..	..	3
1904		..	..	..	..	..	..	..	..	..	1	..	..	1
1905		..	..	..	..	..	..	..	..	..	..	1	1	2
1906		..	..	..	..	..	..	..	1	..	3	1	..	5
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	..	..	..	..	..	..	..	..	..	..	..	....
1910		..	..	..	..	..	..	..	..	1	1	3	1	6
1911	7,436	..	..	..	..	..	..	..	1	1	..	..	..	2
1912		..	..	1	..	1	..	..	..	..	1	..	1	4
		2	1	1	..	1	..	..	2	3	7	5	3	25

COUNTY OF OXFORD

Not including Woodstock

	01													
1902	39,521	1	..	..	..	..	..	..	1	1	1	1	2	7
1903		1	..	..	..	1	..	..	1	..	1	..	..	4
1904		..	..	..	..	1	..	..	..	3	2	4	..	10
1905		..	..	1	..	..	1	1	..	2	1	1	..	7
1906		..	..	..	..	..	..	..	2	5	2	3	..	12
1907		..	..	..	..	..	1	..	1	1	1	..	..	4
1908		..	..	..	..	..	..	..	..	3	3	1	..	7
1909		..	1	1	..	..	..	..	..	..	..	..	..	2
1910		..	..	..	..	..	..	..	1	1	1	1	..	4
1911	36,051	..	..	1	..	..	..	1	1	..	..	2	..	5
1412		..	..	1	..	..	..	..	..	..	..	..	1	2
		2	1	4	..	2	2	2	7	16	12	13	3	64

CITY OF WOODSTOCK

County of Oxford

	01													
1902	8,883	1	..	..	..	..	..	..	..	1	..	..	1	3
1903		..	..	..	..	1	..	..	..	1	..	..	1	3
1904		..	..	..	..	..	..	..	..	2	2	..	..	4
1905		..	1	..	..	..	..	..	..	..	1	1	..	3
1906		..	1	..	..	..	..	..	1	..	1	..	1	4
1907		..	..	..	..	..	..	..	..	..	2	..	..	2
1908		..	..	..	..	..	..	1	1	..	..	1	..	3
1909		..	..	..	..	..	..	..	..	1	..	1	..	2
1910		1	..	..	..	..	..	..	..	..	1	..	..	2
1911	9,320	..	..	..	..	..	..	1	..	1	..	..	2	4
1912		..	..	..	1	..	..	..	..	..	1	1	..	3
		2	2	..	1	1	..	2	2	6	8	4	5	33

DISTRICT OF PARRY SOUND

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	24,936	..	3	1	..	..	..	..	..	2	..	1	..	7
1903		..	..	..	..	..	..	..	..	1	2	..	..	3
1904		..	..	..	1	..	..	..	..	..	4	..	1	6
1905		1	..	1	2	..	2	..	1	2	3	2	1	15
1906		5	2	..	..	..	..	..	2	6	8	7	2	32
1907		2	2	3	..	2	1	1	..	..	3	..	..	14
1908		1	1	..	8	3	..	..	..	1	3	2	1	20
1909		1	..	2	..	..	..	1	3	1	2	..	2	12
1910		..	..	..	..	..	1	1	1	..	1	..	..	4
1911	26,547	..	..	..	..	..	..	2	1	1	2	..	2	8
1912		1	1	1	..	2	..	2	..	1	1	..	..	9
		11	9	8	11	7	4	7	8	15	29	12	9	130

COUNTY OF NORFOLK

	01													
1902	29,147	1	..	2	..	..	..	..	..	1	..	..	..	4
1903		1	..	1	..	..	..	1	..	1	..	..	..	4
1904		..	2	..	..	..	..	..	1	4	1	1	..	9
1905		..	1	..	..	..	..	1	..	2	..	..	..	4
1906		1	..	1	..	..	..	..	1	3	1	1	..	8
1907		..	..	1	..	..	..	..	..	..	..	..	..	1
1908		1	..	2	1	..	..	1	1	2	3	2	..	13
1909		1	1	..	..	..	1	..	..	2	1	..	..	6
1910		..	..	..	..	..	..	..	1	2	2	4	2	11
1911	27,110	1	..	..	..	..	..	2	..	3	1	..	..	7
1912		..	..	..	..	..	..	..	2	3	2	..	..	7
		6	4	7	1	..	1	5	6	23	11	8	2	74

COUNTY OF BRUCE

	01													
1902	59,020	1	..	..	..	1	..	..	1	1	..	..	1	5
1903		1	..	..	1	..	1	..	1	..	..	..	..	4
1904		..	..	..	1	1	..	3	..	3	..	1	1	10
1905		..	..	..	..	..	..	..	1	..	1	..	..	2
1906		..	..	6	..	..	1	..	2	2	2	1	1	15
1907		2	..	..	..	..	1	..	..	2	2	1	1	9
1908		..	..	..	..	2	..	1	2	1	5	2	..	13
1909		..	..	3	1	..	1	1	..	1	1	..	..	8
1910		..	1	..	..	..	..	..	4	1	..	1	2	9
1911	50,032	..	..	..	..	..	..	1	..	3	2	1	..	7
1912		..	..	..	..	..	..	..	..	1	1	..	..	2
		1	1	9	3	4	4	6	11	15	14	7	6	84

COUNTY OF PEEL

	01													
1902	21,475	..	..	..	..	..	..	..	..	..	1	..	..	1
1903		..	2	..	..	..	..	..	..	..	..	1	..	3
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	3	..	..	..	..	1	4
1906		..	..	..	..	..	..	..	1	..	1	..	..	2
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	1	..	..	..	..	..	1
1909		..	..	..	..	1	..	..	..	..	..	..	1	2
1910		1	..	..	1	1	..	..	1	1	..	..	1	6
1911	22,102	..	..	..	1	..	..	..	..	1	..	..	..	2
1912		..	..	..	1	..	..	..	..	..	..	1	..	2
		1	2	..	3	2	..	4	2	2	2	2	3	23

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

COUNTY OF PERTH

Not including Stratford

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	39,912	..	2	..	1	..	..	..	..	..	..	2	..	5
1903		..	1	..	..	..	1	2	..	1	1	2	..	8
1904		..	..	..	..	..	..	..	1	..	2	..	..	3
1905		..	..	..	..	..	..	..	..	..	4	1	..	5
1906		..	..	1	..	..	..	..	1	..	..	1	..	3
1907		..	..	..	..	..	..	..	..	1	..	..	..	1
1908		1	..	..	..	..	..	..	1	..	..	2	..	4
1909		..	..	..	..	..	..	..	..	..	1	..	..	1
1910		..	..	1	..	..	..	..	1	..	1	2	1	6
1911	36,236	..	..	..	1	..	..	..	2	..	..	..	..	3
1912		..	..	..	..	1	..	..	1	..	1	2	..	5
		1	3	2	2	1	1	2	7	2	10	12	1	44

CITY OF STRATFORD

County of Perth

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	9,959	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	2	..	1	3
1904		1	..	..	1	..	1	..	1	1	..	..	..	5
1905		1	..	..	..	..	..	1	..	..	..	1	1	4
1906		..	..	..	..	1	..	..	..	..	..	1	1	3
1907		1	2	..	..	..	..	1	..	..	..	..	..	4
1908		..	..	..	..	..	..	..	..	..	1	1	..	2
1909		..	1	..	..	..	..	..	3	..	1	..	..	5
1910		..	..	..	1	1	2	..	..	..	..	1	..	5
1911	12,946	..	..	..	..	1	..	..	..	..	..	..	1	2
1912		..	..	..	..	..	..	..	..	..	1	2	..	3
		3	3	..	1	3	3	2	4	1	5	6	4	36

COUNTY OF PETERBOROUGH

Not including Peterboro'

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	24,827	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		1	..	..	..	..	..	..	..	1	..	..	..	2
1904		..	..	..	..	..	1	..	..	..	..	..	..	1
1905		..	..	..	..	..	..	..	..	..	..	1	..	1
1906		1	..	..	..	..	..	..	..	..	..	..	..	1
1907		1	..	..	..	..	..	..	1	3	..	..	..	5
1908		..	..	..	..	..	..	..	1	..	1	..	..	3
1909		..	..	..	..	..	..	..	..	..	..	..	1	1
1910		..	..	..	..	1	..	..	1	..	4	..	..	6
1911	23,290	2	1	..	..	..	..	..	..	..	2	..	..	5
1912		..	..	..	1	..	..	..	..	..	..	..	..	1
		5	1	..	1	1	1	..	4	4	7	1	1	26

CITY OF PETERBOROUGH

County of Peterborough

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	11,239	..	1	..	1	..	..	..	..	..	..	..	..	2
1903		..	..	..	..	1	..	..	1	..	1	..	..	3
1904		..	..	..	1	..	4	..	1	..	..	..	1	7
1905		1	1	..	..	..	..	..	..	3	..	1	..	6
1906		..	..	..	..	..	..	..	1	..	..	2	1	4
1907		..	..	..	..	..	..	..	4	..	..	..	..	4
1908		..	..	..	..	..	..	..	..	..	2	1	..	3
1909		..	..	..	..	..	..	..	..	1	..	..	..	1
1910		..	..	..	..	..	..	..	..	..	4	1	..	5
1911	18,360	..	..	..	..	..	..	..	1	1	..	1	..	3
1912		..	1	..	..	..	..	1	..	..	..	..	..	2
		1	3	..	2	1	4	1	8	5	7	6	2	40

COUNTIES OF PRESCOTT AND RUSSELL

Not including Hawkesbury

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	43,167	2	..	..	1	..	3	..	..	..	1	..	1	8
1903		..	..	..	..	..	..	6	2	1	4	..	..	13
1904		..	2	2	..	..	..	1	..	..	2	..	..	7
1905		1	1	1	1	..	..	1	..	..	1	..	2	8
1906		..	..	1	..	..	1	..	1	2	1	..	3	9
1907		1	1	..	1	1	..	..	3	1	..	..	4	12
1908		1	2	..	1	2	1	..	1	..	3	..	1	12
1909		1	1	..	1	..	2	2	1	2	2	..	1	13
1910		1	1	3	1	..	..	1	..	1	1	..	2	11
1911	62,166	1	2	1	..	..	1	..	..	1	..	..	2	8
1912		1	..	1	..	3	..	..	..	..	1	1	..	7
		9	10	9	6	6	8	11	8	8	16	1	16	108

TOWN OF HAWKESBURY

County of Prescott

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	4,150	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		1	..	..	..	..	..	..	..	..	..	..	..	1
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	1	..	..	..	..	..	..	..	1
1907		..	..	..	..	..	..	..	..	..	..	2	..	2
1908		..	..	..	..	..	..	1	..	..	..	1	..	2
1909		1	..	..	..	..	..	1	1	..	..	..	..	3
1910		2	..	..	..	..	..	..	..	..	..	..	..	2
1911	4.236	..	..	..	..	..	..	..	..	..	..	..	..	....
1912		..	..	..	..	..	..	..	..	..	..	..	1	1
		4	..	..	..	1	..	2	1	..	..	3	1	12

COUNTY OF PRINCE EDWARD

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	17,864	..	..	..	..	..	1	..	..	..	..	..	..	1
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	1	..	..	..	..	..	..	1	..	1	3
1905		..	..	..	..	..	..	..	..	..	1	..	..	1
1906		..	..	..	..	..	..	..	1	..	1	..	..	2
1907		..	..	1	..	..	..	..	..	..	2	..	..	3
1908		..	..	..	..	..	..	..	..	1	..	1	..	2
1909		..	..	1	..	..	..	..	..	..	..	1	..	2
1910		..	..	2	..	..	1	..	..	..	1	..	..	4
1911	17,150	..	..	..	..	..	..	..	..	1	..	..	..	1
1912		..	..	..	..	..	..	..	1	..	..	..	..	1
		..	..	5	..	..	2	..	2	2	6	2	1	20

DISTRICT OF SUDBURY

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902		..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	..	..	..	..	..	..	..	..	....
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	..	..	..	..	..	1	1	1	1	2	2	8
1910		1	2	1	..	..	..	1	2	4	8	3	..	22
1911	34,948	..	..	1	1	..	1	..	4	9	9	7	2	34
1912		1	1	..	..	..	1	..	2	1	1	3	5	15
		2	3	2	1	..	2	2	9	15	19	15	9	79

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

COUNTY OF SIMCOE

Not including Barrie, Collingwood, Orillia

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	66,967	..	..	..	..	..	2	..	2	1	2	..	1	8
1903		1	..	..	1	..	1	..	2	1	1	..	3	10
1904		1	..	..	..	1	..	1	1	..	2	..	1	7
1905		..	..	..	..	..	..	..	2	1	1	..	2	6
1906		3	2	1	3	3	1	..	..	1	2	..	1	17
1907		1	2	1	1	2	..	2	..	..	..	1	..	10
1908		..	..	..	..	..	..	2	6	2	..	3	..	13
1909		..	1	..	1	..	1	..	1	2	2	..	1	9
1910		..	..	1	..	1	..	..	2	3	..	..	1	8
1911	64,805	1	..	..	..	..	..	2	4	1	1	1	..	10
1912		1	..	1	..	..	..	..	..	..	1	..	2	5
		8	5	4	6	7	5	7	20	12	12	5	12	103

TOWN OF BARRIE

County of Simcoe

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	5,949	..	..	..	1	..	..	..	1	..	1	..	..	3
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	..	1	..	..	1
1905		1	2	..	..	..	..	..	1	..	2	..	..	6
1906		..	1	..	..	..	..	..	1	1	4	1	..	8
1907		1	1	..	1	..	1	1	..	..	..	..	..	5
1908		1	1	..	..	..	..	2	..	..	1	..	..	5
1909		..	..	1	..	1	..	..	..	4	1	..	..	7
1910		1	..	1	..	1	..	..	1	1	..	1	..	6
1911	6,420	..	1	..	..	..	..	..	..	..	..	..	..	1
1912		..	..	..	..	..	..	1	..	..	1	1	..	3
		4	6	2	2	2	1	4	4	6	11	3	..	45

TOWN OF COLLINGWOOD

County of Simcoe

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	5,755	..	..	..	..	..	1	..	..	..	..	..	..	1
1903		..	..	1	..	..	..	..	1	..	..	..	..	2
1904		..	..	1	..	..	..	..	..	1	..	..	..	2
1905		..	..	..	..	..	..	..	..	..	1	..	..	1
1906		..	..	..	..	2	..	..	..	..	2	2	..	6
1907		1	..	..	..	..	..	..	..	..	1	..	..	2
1908		..	..	..	..	..	..	..	..	1	2	2	..	5
1909		1	..	..	..	..	..	2	..	..	2	..	..	5
1910		1	1	..	..	..	1	1	..	1	1	..	..	6
1911	7,000	1	..	..	..	..	2	..	..	..	..	..	..	3
1912		..	..	..	..	..	..	..	..	..	..	..	1	1
		4	1	2	..	2	4	3	1	3	9	4	1	34

TOWN OF ORILLIA

County of Simcoe

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	3,914	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	1	..	..	..	1
1905		..	..	..	1	..	..	..	..	..	..	..	..	1
1906		..	..	..	..	..	..	..	1	..	..	..	..	1
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	..	..	..	..	..	..	..	2	..	4	1	7
1910		..	..	..	1	..	..	2	..	..	..	..	..	3
1911	6,828	..	..	..	..	..	..	2	..	1	1	..	..	4
1912		..	..	..	..	..	..	..	2	..	1	..	..	3
		..	..	..	2	..	..	4	3	4	2	4	1	20

COUNTY OF RENFREW

Not including Arnprior, Pembroke

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	43,410	1	..	2	..	..	..	..	1	..	1	1	..	6
1903		..	..	..	..	2	..	..	1	..	1	1	..	5
1904		..	..	..	1	1	..	..	5	..	2	..	..	9
1905		..	..	..	..	..	..	..	1	..	2	1	2	6
1906		1	2	1	1	..	..	1	..	1	2	1	3	13
1907		2	7	..	..	..	1	..	..	..	..	..	1	11
1908		1	..	..	..	..	1	..	2	..	1	..	..	5
1909		..	..	1	1	..	1	..	1	..	2	..	2	8
1910		1	1	..	..	..	..	..	..	..	1	2	..	5
1911	42,036	4	1	..	..	..	1	1	1	..	..	..	..	8
1912		..	..	..	..	..	..	..	1	..	..	..	..	1
		10	11	4	3	3	4	2	13	1	12	6	8	77

TOWN OF ARNPRIOR

County of Renfrew

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	4,146	..	..	..	..	..	1	..	..	..	..	..	1	2
1903		..	..	1	..	..	..	..	..	..	..	..	..	1
1904	....	..	..	..	..	..	..	..	..	1	..	..	..	1
1905		..	1	..	..	..	..	..	..	..	..	..	..	1
1906		..	..	..	..	..	..	..	1	..	..	1	..	2
1907		..	..	..	..	..	1	1	..	..	..	1	..	3
1908		..	..	..	..	..	..	..	..	1	..	1	..	2
1909		..	..	..	..	..	..	..	..	..	..	..	..	....
1910		..	..	..	..	..	1	..	..	1	..	..	..	1
1911	4,164	..	..	..	..	..	..	..	..	..	..	..	..	....
1912		..	..	..	..	..	..	..	..	..	..	..	..	....
		..	1	1	..	..	3	1	1	3	..	3	1	13

TOWN OF PEMBROKE

County of Renfrew

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	5,156	2	..	..	..	1	..	..	..	..	1	..	..	4
1903		..	..	..	..	..	..	..	..	..	..	..	1	1
1904		..	..	..	..	..	1	..	..	3	..	..	..	4
1905		1	..	..	..	..	..	..	2	3	..	1	2	9
1906		5	1	..	..	..	..	..	1	2	2	4	4	19
1907		..	..	..	..	..	..	..	..	2	..	..	1	3
1908		1	..	..	..	..	..	..	..	..	2	5	8	16
1909		6	..	1	..	..	..	..	1	4	1	4	..	17
1910		..	..	..	..	1	..	..	1	1	4	..	..	7
1911	5,686	1	..	1	2	..	..	..	..	..	1	1	1	7
1912		..	..	..	..	..	..	..	..	1	2	..	..	3
		16	1	2	2	2	1	..	5	16	13	15	17	90

COUNTIES OF STORMONT, DUNDAS AND GLENGARRY

Not including Cornwall

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	62,226	..	1	..	..	..	..	..	..	1	..	1	..	3
1903		1	1	..	..	..	..	..	..	3	..	1	3	9
1904		..	..	1	..	1	1	3	..	..	1	1	..	8
1905		..	..	..	..	1	..	1	1	1	2	2	1	9
1906		1	..	..	..	..	1	1	..	1	1	1	1	7
1907		..	2	..	..	1	..	2	..	..	..	1	1	7
1908		..	..	3	1	2	..	1	2	6	..	2	..	17
1909		..	1	..	..	..	..	2	..	1	1	..	..	5
1910		..	..	..	..	..	..	..	1	..	..	..	..	1
1911	57,601	..	1	1	1	..	..	..	..	..	2	1	..	7
1912		1	..	..	2	..	..	..	..	..	2	1	..	6
		3	6	5	4	5	2	10	5	13	9	11	6	79

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

TOWN OF CORNWALL

County of Stormont

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	6,704	..	2	..	..	..	..	..	1	1	..	..	..	4
1903		1	..	..	..	..	..	..	..	..	1	..	..	2
1904		..	..	..	..	..	1	..	1	1	..	..	..	3
1905		..	..	..	..	..	1	..	1	..	..	..	..	2
1906		..	..	1	..	..	1	..	..	1	..	2	1	6
1907		1	1	1	1	..	..	..	..	..	..	..	1	5
1908		2	1	1	..	..	..	..	..	..	..	3	..	7
1909		..	1	..	..	..	..	..	..	..	1	2	..	4
1910		2	..	..	1	1	..	..	..	..	..	..	..	4
1911	6,598	..	..	..	..	..	1	..	..	..	1	..	1	3
1912		..	1	1	..	..	..	..	2	..	..	..	..	4
		6	6	4	2	1	4	..	5	3	3	7	3	44

CITY OF BERLIN

County of Waterloo

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	9,747	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	1	..	..	..	1	..	1	..	3
1904		..	..	..	..	..	..	..	1	..	..	..	..	1
1905		..	..	..	..	..	..	..	..	..	1	1	..	2
1906		1	..	..	..	..	..	..	..	..	..	1	..	2
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	..	1	..	..	1	2
1909		..	..	..	..	..	..	..	..	1	1	..	..	2
1910		..	..	1	..	..	..	..	2	1	1	..	1	6
1911	15,196	..	..	..	..	..	..	..	..	..	..	..	1	1
1912		1	..	..	..	..	..	..	..	..	..	1	1	3
		2	..	1	..	1	..	..	3	4	3	4	4	22

COUNTY OF VICTORIA

Not including Lindsay

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	24,949	1	..	1	1	..	..	..	..	..	..	..	1	4
1903		1	..	..	..	..	..	..	..	..	1	..	..	2
1904		1	..	..	..	..	..	1	1	..	..	..	..	3
1905		..	..	..	..	..	..	..	..	2	1	..	..	3
1906		..	..	..	..	1	..	..	1	..	..	1	..	3
1907		..	..	..	..	..	1	..	1	..	..	1	..	3
1908		..	..	..	2	..	..	..	..	1	1	..	..	4
1909		..	..	..	..	..	..	..	1	..	..	1	1	3
1910		1	..	..	..	..	..	..	..	..	..	..	..	1
1911	24,226	..	..	..	..	1	..	1	1	..	1	2	1	7
1912		..	..	..	..	..	..	..	..	..	..	..	..	....
		4	..	1	3	2	1	2	5	3	4	5	3	33

TOWN OF GALT

County of Waterloo

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	8,051	..	..	..	..	..	..	..	..	..	1	..	..	1
1903		..	..	1	..	..	..	..	1	..	..	..	..	2
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	..	1	1	..	1	..	2	..	5
1907		..	..	..	..	..	..	..	1	..	..	..	..	1
1908		..	..	..	1	..	..	1	..	..	..	2	..	4
1909		1	..	..	..	..	..	..	..	..	..	..	..	1
1910		..	..	1	..	..	..	..	..	2	..	..	1	4
1911	10,299	..	..	1	1	..	..	..	..	1	..	..	..	3
1912		1	..	1	..	..	..	..	..	..	..	..	..	2
		2	..	4	2	..	1	2	2	4	1	4	1	23

TOWN OF LINDSAY

County of Victoria

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	7,003	..	..	..	..	..	..	..	..	2	1	..	..	3
1903		..	..	..	..	..	..	..	..	..	..	..	1	1
1904		..	..	..	..	..	..	1	..	1	1	..	..	3
1905		..	..	..	..	2	..	..	1	..	1	1	..	5
1906		..	..	..	..	..	..	1	..	..	..	1	..	2
1907		1	..	..	..	..	..	..	..	..	..	..	..	1
1908		..	..	..	..	..	..	..	1	1	..	..	1	3
1909		..	..	..	..	..	1	..	..	1	1	..	..	3
1910		..	..	1	..	..	1	..	..	..	1	2	..	5
1911	6,964	..	..	..	..	..	..	..	..	..	2	..	..	2
1912		..	..	..	..	1	2	..	..	..	..	..	..	3
		1	..	1	..	3	4	2	2	5	7	5	1	31

COUNTY OF WELLAND

Not including Niagara Falls, Welland

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	24,023	1	..	1	1	..	..	..	..	1	..	..	1	5
1903		..	..	..	..	1	..	1	1	..	..	1	..	4
1904		1	..	..	..	..	..	1	..	..	1	..	..	3
1905		..	..	..	..	..	..	..	1	1	1	..	..	3
1906		..	1	..	..	1	..	..	..	1	2	2	..	7
1907		..	2	..	..	..	..	1	2	..	1	..	1	7
1908		2	1	..	..	..	..	1	..	..	1	1	..	6
1909		..	..	..	..	..	..	..	..	1	1	..	..	2
1910		..	..	..	..	..	..	..	..	..	1	1	..	2
1911	27,597	..	..	..	1	..	..	..	..	1	..	..	..	2
1912		..	..	..	..	1	..	..	..	..	1	2	..	4
		4	4	1	2	3	..	4	4	5	9	7	2	45

COUNTY OF WATERLOO

not including Berlin, Galt

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	34,796	..	..	..	..	..	..	..	1	2	..	..	..	3
1903		..	..	..	..	..	..	1	..	..	1	..	..	2
1904		..	1	1	1	1	..	..	1	..	1	1	..	7
1905		1	1	..	..	..	..	..	1	..	..	3	..	6
1906		..	..	1	2	..	2	..	2	1	3	1	..	12
1907		1	..	1	..	1	1	..	1	..	1	..	..	6
1908		..	..	..	..	..	..	1	1	..	1	2	1	6
1909		..	..	..	1	..	..	..	1	..	..	1	..	3
1910		1	..	1	..	1	..	..	1	..	..	..	..	4
1911	36,112	..	..	..	..	..	1	..	1	..	1	..	..	3
1912		..	..	..	..	..	1	..	..	1	2	..	..	4
		3	2	4	4	3	5	2	10	4	10	8	1	56

TOWN OF WELLAND

County of Welland

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	1,863	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	..	..	..	..	..	..	..	..	....
1907		..	..	..	..	..	..	..	..	..	1	..	..	1
1908		..	..	..	..	..	..	..	..	..	..	..	..	....
1909		..	..	..	..	..	..	..	..	..	..	..	..	....
1910		..	1	..	..	..	1	..	..	..	1	1	..	4
1911	5,318	..	..	..	..	..	..	..	..	..	1	1	1	3
1912		1	..	..	..	..	..	..	..	..	..	..	1	2
		1	1	..	..	..	1	..	..	..	3	2	2	10

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

CITY OF NIAGARA FALLS
County of Welland

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	5,702	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	1	..	..	..	..	..	1
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		1	1	1	..	..	..	..	..	..	..	..	..	3
1907		1	1	..	..	..	..	..	..	..	..	..	1	3
1908		..	2	1	1	2	..	..	..	..	..	..	..	6
1909		2	..	..	..	..	..	..	..	..	..	..	..	2
1910		..	..	2	..	..	2	1	..	..	..	..	..	5
1911	9,248	..	..	1	..	3	1	..	2	..	..	..	1	8
1912		1	..	..	..	..	1	1	..	1	1	..	..	4
		5	4	5	1	5	4	3	2	1	1	..	2	32

CITY OF HAMILTON
County of Wentworth

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	52,634	..	..	..	1	..	..	1	2	1	1	1	3	10
1903		..	..	..	..	..	..	..	1	..	2	..	1	4
1904		..	1	..	2	1	..	..	..	3	1	..	1	9
1905		1	1	1	..	2	1	..	1	..	3	2	1	13
1906		..	..	1	..	1	1	2	1	2	8	3	..	19
1907		..	..	..	..	..	1	..	1	2	2	..	1	7
1908		1	1	..	..	..	..	2	1	3	4	1	..	13
1909		1	..	1	..	..	..	1	..	3	..	1	4	11
1910		..	2	..	..	..	1	2	2	1	3	..	..	11
1911	81,969	1	2	1	..	..	2	3	..	2	2	5	..	18
1912		1	..	..	..	..	..	1	1	2	1	1	..	7
		5	7	4	3	4	6	12	10	19	27	14	11	122

COUNTY OF WELLINGTON
Not including Guelph

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	44,150	1	1	1	2	1	1	1	2	1	..	1	1	13
1903		..	2	..	..	..	..	2	..	..	2	..	..	6
1904		1	..	..	..	..	..	..	2	1	1	..	1	6
1905		..	..	..	..	1	..	..	..	1	4	1	..	7
1906		..	1	..	1	..	..	..	..	2	4	1	1	10
1907		2	2	..	..	..	..	..	..	1	..	..	..	5
1908		..	..	..	..	..	..	2	1	3	2	1	1	10
1909		1	..	..	..	..	..	..	..	2	1	1	1	6
1910		..	..	..	..	1	1	..	..	2	2	1	..	7
1911	39,317	..	..	1	1	..	1	..	1	3	..	..	1	8
1912		..	..	1	..	..	..	..	..	..	..	..	..	1
		5	6	3	4	3	3	5	6	16	16	6	6	79

COUNTY OF YORK
Not including Toronto, North and West Toronto

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	63,761	..	..	1	..	1	1	..	1	3	1	2	..	10
1903		..	3	1	..	..	..	2	..	4	..	1	..	11
1904		1	1	2	1	2	5	..	..	4	2	1	3	22
1905		..	..	..	..	..	..	..	4	2	1	2	3	12
1906		1	..	1	1	..	..	1	1	6	2	2	2	17
1907		..	..	..	..	..	..	..	..	2	2	3	2	9
1908		..	..	1	1	1	2	2	3	..	5	2	3	20
1909		2	..	2	2	..	2	1	2	1	4	1	2	19
1910		2	2	..	..	1	..	..	2	..	5	2	..	14
1911	62,064	..	..	..	3	..	..	..	..	3	6	1	..	13
1912		..	..	..	..	..	..	..	..	..	3	2	..	5
		6	6	8	8	5	10	6	13	25	31	19	15	152

CITY OF GUELPH
County of Wellington

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	11,496	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	1	1	..	2
1904		..	..	..	..	..	..	..	..	1	..	..	..	1
1905		..	..	..	..	..	..	..	..	2	..	..	..	2
1906		..	..	..	..	..	1	..	..	..	..	..	..	1
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	1	..	1	..	1	3
1909		..	1	..	..	..	..	..	..	..	..	..	..	1
1910		..	..	..	1	..	..	..	2	..	..	..	1	4
1911	15,175	..	..	..	..	..	..	..	..	..	1	1	..	2
1912		..	..	..	..	..	..	..	..	..	..	..	1	1
		..	1	..	1	..	1	..	3	4	3	1	3	17

CITY OF TORONTO
County of York

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	208,040	5	3	..	2	1	..	4	..	4	2	3	6	30
1903		4	3	4	3	1	3	1	1	2	7	5	4	38
1904		4	2	3	6	3	6	1	7	7	4	7	6	56
1905		7	2	3	4	1	1	10	4	2	4	3	..	41
1606		1	5	7	3	1	..	4	14	11	5	10	9	70
1907		3	7	5	2	4	4	2	3	8	9	8	3	58
1908		7	3	3	6	4	1	10	5	6	8	5	2	60
1909		3	3	5	11	6	3	6	3	11	12	5	9	77
1910		18	18	24	10	8	5	5	14	15	17	11	6	151
1911	376,538	5	4	5	2	5	4	2	14	11	15	6	9	82
1912		4	6	4	2	2	4	1	6	8	6	7	4	54
		61	56	60	50	39	31	37	77	87	87	71	61	717

COUNTY OF WENTWORTH
Not including Hamilton

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	26,818	..	..	..	1	..	..	..	..	..	1	1	..	3
1903		..	..	..	..	..	..	..	..	..	..	..	1	1
1904		..	..	..	1	..	..	..	3	..	..	..	..	4
1905		..	..	1	2	..	..	..	..	3	1	1	..	8
1906		2	1	..	..	..	..	..	1	..	2	1	..	7
1907		..	..	..	..	..	..	..	1	1	1	..	2	5
1908		..	..	..	..	..	..	..	..	..	1	..	..	1
1909		..	..	1	..	..	1	..	..	..	..	..	..	2
1910		..	..	1	..	..	2	..	..	..	..	1	..	4
1911	29,677	..	..	..	..	..	2	..	..	1	2	..	..	5
1912		..	1	..	1	..	..	1	1	..	2	..	..	6
		2	2	3	5	..	5	1	6	5	10	4	3	46

WEST TORONTO
County of York

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	6,091	..	..	1	..	1	..	..	..	..	..	..	..	2
1903		1	1	..	..	..	..	..	..	..	..	1	..	3
1904		1	..	..	..	..	1	..	2	..	..	..	..	4
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		1	..	1	..	..	..	1	1	1	..	..	1	6
1907		..	..	..	..	..	..	..	..	1	..	1	2	4
1908		..	..	1	..	1	2	2	1	1	2	2	..	12
		2	1	4	..	2	3	3	4	3	2	4	3	31

TYPHOID FEVER STATISTICS, PROVINCE OF ONTARIO.

Deaths from Typhoid Fever by years and by months, 1902-1912, inclusive.

TOWN OF NORTH TORONTO

County of York

Year	Population	January	February	March	April	May	June	July	August	September	October	November	December	Total
	01													
1902	862	..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	1	1
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1005		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	..	..	..	..	..	..	..	..	....
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	..	..	..	..	..	..	1	..	..	1
1909		..	..	..	..	..	1	..	..	..	..	..	..	1
1910		..	..	..	..	..	..	..	..	..	1	..	..	1
1911	5,632	..	..	..	..	..	..	..	..	..	..	..	..	....
1912		..	..	..	1	1	..	1	1	3	..	..	..	7
		..	..	..	1	1	1	1	1	3	2	..	1	11

TOWN OF STEELTON

District of Algoma

Year	Populatirn	January	February	March	April	May	June	July	August	September	October	November	December	Total
1902		..	..	..	..	..	..	..	..	..	..	..	..	....
1903		..	..	..	..	..	..	..	..	..	..	..	..	....
1904		..	..	..	..	..	..	..	..	..	..	..	..	....
1905		..	..	..	..	..	..	..	..	..	..	..	..	....
1906		..	..	..	..	..	..	..	..	1	..	1	..	2
1907		..	..	..	..	..	..	..	..	..	..	..	..	....
1908		..	..	..	1	..	..	..	..	..	1	..	..	2
1909		..	..	..	..	..	..	..	..	..	..	..	..	....
1910		..	..	..	..	..	..	..	..	..	..	..	..	....
1911	3,178	..	..	..	..	..	..	..	1	..	..	..	1	2
1912		..	..	..	..	..	..	1	..	..	..	..	..	1
		..	..	..	1	..	..	1	1	1	1	1	1	7

Reports of Medical Inspector R. W. Bell, M.D.

REPORT *RE* SITE GUELPH WATER SUPPLY AND PROPOSED ELECTRIC RAILWAY LINE THROUGH IT.

To the Secretary, Provincial Board of Health, Ontario.

Sir,—Having visited Guelph as instructed on the 8th inst., to look over the location of the civic water supply. through which a survey for an electric railway has been made, with a view to any possibility of pollution of the water or any interference with sanitary conditions, I beg to report that I found the civic-owned property to consist of 165 acres bordering on Eramosa Creek. For 50 to 100 yards back from the creek the ground is low and damp and well wooded mostly with cedars; then it rises somewhat abruptly, the higher ground being denuded of timber. The water is collected from springs on the hillside underground and conducted to the main conduit, thence to the city and not exposed to any contamination before reaching the taps.

The proposed railway line runs through nearly the whole length of the property, but as it is on the lower level below the springs, I do not see how there is any likelihood of pollution of the water supply. There is, however, another aspect of the case which might affect the sanitary conditions of the city from a probable diminution of the supply, which should rather be increased if possible than decreased, and it is this—the upper levels and hillside being, as I said before, denuded of trees are being reforested by the setting out of two or three hundred thousand trees to conserve the supply. I fear the clearing of a sixty-six foot right of way through the present protected area on the lower level will to a considerable extent counteract the conservation by allowing this exposed section to become rapidly dried up and draw the increased reserve from the hillside, thus depriving the city of the much desired increase in its supply, which is a necessity in preserving good sanitary conditions in a rapidly advancing population.

All this can be to a very great extent avoided by the line crossing the creek and running down the opposite side and recrossing beyond the civic property, although even here there might be a slight interference, as there is a small portion of the water location with a spring on the other side of the creek. There were other objections advanced by the Water Commissioners, but as these were of an æsthetic aspect I have nothing to report thereon.

R. W. Bell,
Provincial Inspector of Health.

April 19th, 1913.

REPORT *RE* NUISANCE AT FOOT OF CARLAW AVE., TORONTO.

To the Secretary of the Provincial Board of Health, Ontario.

Sir,—As directed by you I yesterday (January 9th) investigated a complaint *re* nuisance at foot of Carlaw Avenue. There I found a sewer discharging into Ashbridge's Bay a large quantity of sewage from that part of the city. As the water for a considerable distance out was frozen over, it was impossible to see the condition satisfactorily along the shore line, but sufficient was seen to pronounce the situation most unsanitary and disgraceful.

On cutting a hole through the ice about 10 feet from shore in rear of Schofield and Holden's boat repair works, we found about two feet of water, where I am informed a short time ago there was seven feet, and on taking a dip with a long-handled bucket we got a pail full of pure filth. The same at twenty feet from shore in four feet of water. Through this boats for repairs have to be dragged and those seen on their cradles were smeared with this filth which had to be washed off before they can be taken into the works—a most disgusting job. A certain amount of dredging I understand was done here during the past season, but bringing about no relief. A former channel with a current through it kept the place fairly clear, but this is blocked up and causes the present trouble. A similar condition with a broken wooden box sewer exists at Logan Avenue, one block west.

Before the ice formed and in warm weather the condition must have been horrible, and should be remedied without delay.

R. W. Bell,
Provincial Inspector of Health.

Toronto, January 10th, 1913.

REPORT *RE* UNSANITARY CONDITIONS IN ASHBRIDGE'S BAY, FOOT OF CARLAW AVENUE.

To the Secretary of the Provincial Board of Health, Ontario.

Sir,—On January last by your instruction I made an inspection of the unsanitary conditions existing at the foot of Carlaw Avenue in this City and reported them as very bad. Complaint having again been made regarding them I yesterday, August 22nd, visited the locality and find there is no improvement, in fact very much worse as can well be understood, the previous inspection having been made in mid-winter when the bay was covered with ice except just around the sewer outlet.

At the present time the sewage from a large section of the City is discharged through a concrete sewer about 100 feet out in Ashbridge's Bay from the foot of the street. When a south, south-easterly or south-westerly wind blows much of this sewage is blown back along the shore line of the street and adjoining lots where I saw large quantities of excreta deposited from it. On either side of the street there are boat repair shops and through this filth boats have to be dragged for repairs. At the mouth of the sewer excreta is continually rising to the surface and a few yards beyond as I saw a small launch pass, solid filth rose in many places to the surface with a swirl in buckets full. The stench was unbearable. To the workmen in the adjoining shops and residents for considerable distance from the shore the nuisance must be almost intolerable. The men might about as well work in a cesspool. It certainly is a menace to the health of all mentioned. I never in all my experience saw a worse condition and it is one which requires immediate abatement if serious consequences are not to ensue.

R. W. Bell,
Provincial Inspector of Health.

Toronto, Aug. 23rd, 1913.

REPORT OF THE PROVINCIAL SANITARY ENGINEER.

F. A. DALLYN, B.A.Sc., C.E., (TOR.).

To the Chairman and Members of the Provincial Board of Health, Ontario.

Gentlemen:—

I have pleasure in presenting herewith my report for the year ending December 31st, 1913.

The office of Provincial Sanitary Engineer was created by the Legislature in 1913. Previous to this my duties were those attached to the office of Engineer in charge of the Experimental Station. The investigation of the pollution of the boundary waters between Canada and the United States by the International Joint Commission, together with the preparation of the report of their sanitary experts among whom I had the honour to be included, engaged the greater portion of my attention during the year 1913. The early portion of the year was taken up in preliminary considerations as to the methods of carrying on the survey, designing of apparatus and arranging for laboratory equipment suitable for work of this magnitude.

In addition to this, the work engaging my attention during the year was briefly as follows:

Applications relating to approval for new water works systems, changes and extensions to existing systems, new sewerage systems, common sewers and sewage disposal plants were received and reported upon from the following municipalities:

SEWAGE DISPOSAL.

Municipality.	Date of Approval.	Municipality.	Date of Approval.
New Liskeard	Jan. 25	Perley Home, Ottawa	Sept. 29
Hamilton	Feb. 1	Leaside	" 30
Dominion Canners, Ltd.	" 1	Beaver Board Co., Thorold	Oct. 2
J. W. Woods, Grafton, Ont.	April 15	Schreiber	" 10
Kenora	" 23	Sudbury	" 29
Vineland Canning Co.	" 28	Ingersoll	" 30
Vankleek Hill	June 14	Oakville (June 26, 1911)	" 30
Beaver Board Co., Thorold	Sept. 4	Barrie Tannery	Nov. 13
Hospital for Insane, Whitby	" 26	Berlin Glue Works	Dec. 18
Plant at Mimico	" 26	Wallaceburg	" 31

SEWER EXTENSIONS.

Municipality.	Date of Approval.	Municipality.	Date of Approval.
Windsor	Jan. 2	Stratford	" 22
Toronto	" 8	Smith's Falls	April 3
Toronto	" 9	Haileybury	" 5
Toronto	" 22	Welland	" 12
New Liskeard	" 25	Hamilton	" 12
Hamilton	" 27	Barrie	" 18
North Bay	" 27	Barrie	" 21
Toronto	Feb. 10	Berlin	" 21
Galt	" 7	Peterboro	May 5
Windsor	Mar. 6	Fort Frances	" 5
Welland	" 10	Waterloo	" 14
Chatham	" 15	Toronto	" 14
Sandwich	" 17	Welland	" 14
Collingwood	" 18	Smith's Falls	" 16

Municipality.	Date of Approval.
Barrie	" 22
Port Arthur	" 29
Fort William	June 2
Toronto	" 5
Vankleek Hill	" 14
Smith's Falls	" 23
Fort Frances	" 23
Chatham	" 23
Toronto	" 23
Hamilton	" 25
Smith's Falls	" 30
Galt	" 30
Waterloo	" 30
Walkerville	July 8
Barrie	" 7
Cobourg	" 8
Toronto	" 8
Welland	" 8
Kingston	Aug. 30
Fort William	" 30
Gladstone	" 30
Sandwich West	" 30
Toronto	" 30
Niagara Falls	Sept. 4
Weston	" 9
Merritton	" 29
Smith's Falls	Sept. 30
Galt	" 29
Waterloo	" 29
Lorneville	" 30
Welland	" 29
Fort William	Oct. 2
Simcoe	" 2
Barrie	" 6
Ottawa	" 10
Peterboro	" 10
Port Hope (private sewer)	" 12
Oakville	" 16
Ottawa	" 16
Hamilton	" 29

Municipality.	Date of Approval.
Sudbury	" 29
Welland	" 29
Windsor	" 30
Ingersoll	" 30
Windsor (private sewer)	" 30
Port Hope	Nov. 3
Waterloo	" 3
Ottawa	" 6
Toronto	" 8
Oakville	" 9
Welland	" 11
Ottawa	" 13
Ottawa	" 15
Hamilton	" 17
Windsor	" 21
Ottawa	" 20
Ottawa	" 21
Port Arthur	" 20
Wingham	" 24
Toronto	" 25
Ottawa	" 25
Hamilton	" 25
St. Thomas	" 26
Port Hope	" 29
Ottawa	Dec. 2
Kingston	" 5
Waterloo	" 9
Sarnia	" 10
St. Catharines	" 11
Fort William	" 12
Ottawa	" 16
Galt	" 18
Picton	" 24
Ottawa	" 23
Ottawa	" 23
New Liskeard	" 23
Ottawa	" 31
Toronto	" 31
Windsor	" 31
Hamilton	" 31

NEW WATER SUPPLIES.

Municipality.	Date of Approval.
Cochrane	Feb. 27
Leaside	Sept. 10
Stamford Township	" 30
Ottawa (scheme of Sir Alex. Binnie—"Gatineau Scheme")	Oct. 15

Municipality.	Date of Approval.
Tottenham	Nov. 29
Norwich	Dec. 11
Copper Cliff	" 18
Froode Mine	" 18
Wallaceburg	" 31

WATER WORKS EXTENSIONS.

Municipality.	Date of Approval.
Dundas	Jan. 2
Toronto	" 10
Sandwich	" 14
Port Arthur	" 16
Woodstock	Feb. 8
Weston	" 8
Port Arthur	" 21
Toronto	" 24
Toronto	Mar. 6
Collingwood	" 18

Municipality.	Date of Approval.
Toronto	" 18
Sarnia (auxiliary supply)	" 18
Midland	" 19
Hamilton	April 8
Fort William	" 22
St. Thomas	" 30
Waterloo	" 30
Galt	May 13
Alliston	" 15
Haileybury (Water Purification)	" 15

WATER WORKS EXTENSIONS.—*Continued.*

Municipality.	Date of Approval.
Galt	" 16
Guelph	" 21
Port Stanley	" 21
Galt	" 21
Port Arthur	" 29
Preston	" 30
Leamington	June 6
Port Arthur	" 6
Toronto	" 10
Sandwich	" 20
Fort Frances	" 23
Preston	July 4
Toronto	" 8
Preston	Aug. 30
Sudbury	" 30
Toronto	" 28
Brampton	Sept. 4
Toronto	" 6
Hamilton	" 8
Preston	" 13
Chapleau	" 29
Kingston	" 29
Hamilton	" 29
Hamilton	Oct. 3
Toronto	" 7
Windsor	" 6
Ottawa	" 15
London	" 17
Oakville	" 19
Preston	" 27
Brighton	" 29
Wingham	" 29
Toronto	Nov. 6
Woodstock	" 7
Windsor (March 3, 1914)	" 11
Chesley	" 11
Timmins	" 13
Hamilton	" 17
Preston	" 18
Port Arthur	" 20
Hamilton	" 25
Port Colborne	" 29
Orillia	" 29
Weston	Dec. 1
Toronto	" 9
Peterboro	" 9
Renfrew	" 11
Hamilton	" 12
Picton	" 24
New Liskeard	" 23

In connection with the work affecting water works and sewerage, examination has been made into the available statistics for Ontario, with the following results:

Ontario has approximately:

276 incorporated cities, towns and villages.

184 of which have installed fire protection or water supply, and

79 have installed sewerage systems.

28.5 *per cent. sewered.* 71.5 *per cent. unsewered.*

Of the 79 municipalities (or 28.5 per cent. of the total number) probably as much as 40 per cent. of the population remains unconnected to the sewerage systems in many municipalities.

Associated with this condition we have, according to the statistics for the last ten years, a typhoid death rate of 24.4 per 100,000 of population in the Province. This does not compare at all favourably with the European statistics, which show rates over large areas as low as 8 per 100,000. It seems altogether probable that the existence of many infective centres, arising out of polluted water supplies, together with the possibility of extensive fly-transmission because of the lack of proper sewerage, is accountable for this comparatively high rate. I would respectfully suggest that, having in view these facts, it is advisable for all urban municipalities to pass by-laws which would make possible the compulsory screening and protection of outhouses. The State of Minnesota has passed legislation affecting this. Possibly an amendment to the Municipal Act reading as follows would be of material assistance:

"It shall be the duty of the council of all municipalities to pass by-laws respecting the protection and screening of privies, privy vaults and cesspools and the disposal of the contents thereof, to the end that flies neither find free access thereto nor breed therein."

The character of the by-law suggested which would affect those centres where sewerage systems have been partially installed and where complete sewerage sys-

tems have been installed, but the houses have not all been connected up thereto, might be as follows:

"It shall be the duty of all owners, lessees and occupants of real property within the area of the municipality of .... as defined in the schedule hereunto annexed, and they are hereby notified, that the construction or maintenance of unscreened earth closets, privies or privy vaults is prohibited. And it shall be the duty of all owners, lessees and occupants of real property within the area of the municipality of .... defined in the schedule hereunto annexed, to provide for the proper removal of the contents of all water-closets, privies and privy vaults, to the end that flies neither find access thereto or breed therein.

"Further, where sewers are accessible, and upon the construction of such sewers, owners, lessees and occupants are hereby required to fill up or cause to be filled up or closed all water closets, privy vaults, privies and cesspools within a period of 60 days upon the order of the City Engineer, and connect with adjacent sewers."

INVESTIGATIONS WERE MADE AT THE FOLLOWING PLACES:

Berlin, January 21st.

Upon the request of the municipality, an examination was made as to whether the capacity of the proposed new main trunk sewer was such as would serve the growing needs of the city. The plans, together with the other necessary information, were examined, a visit was made to Berlin and a report prepared showing the proposed sewer to be of a capacity sufficient to serve a population of 52,000 people at 80 gallons per capita, which is 20 gallons more than the present per capita consumption. Berlin is sewered on the separate system plan.

The intermittent sand filters at the sewage disposal area were visited and appeared to be operating satisfactorily; the beds were covered over with ice and no raw sewage was visible.

Detroit, February 16th.

In the interests of the Town of Amherstburg, I presented evidence before the International Joint Commission re the possible effect of the proposed changes in the Livingstone Channel upon the water supply of Amherstburg, the evidence being in the main that the increased flow of sewage past the town by reason of the improvements would unquestionably increase the infection at the source of supply, the infection being entirely dependent on the presence of specific organisms causing water-borne diseases. If the sewage comes from more numerous infected zones, then the pathogenic organisms would be more frequently present and the typhoid rate, as well as the general death rate due to other water-borne diseases, would increase in a greater proportion than the proportional increase in the flow of sewage. The total quantity of sewage at present being discharged into the Detroit River above Amherstburg is approximately 135,000,000 gallons per day. Further, the gross particles held in suspension, due to the increased velocity anticipated because of the works proposed, will augment the present bad condition of the Amherstburg water supply and increase the menace of typhoid and other water-borne diseases.

Leamington, February 20th.

A visit was made to Leamington in company with Dr. Bentley for the purpose of discussing the general situation in reference to sewerage and drainage of the town. The sub-soil at Leamington is mainly of a sandy nature with the ground water standing from four to eight feet from the surface. In view of this high ground water, I suggested that it would be advisable for the present to construct such drains as would lower the ground water and defer the construction of a sewerage system to some later date when the construction would be much less expensive, especially in view of the fact that the present sanitary conditions in Leamington were rather good and that the use of sub-soil drainage had met with considerable success.

Kingston, March 7th.

Upon the request of Mr. E. R. Rogers, Inspector of Prisons and Asylums, and Dr. E. Ryan, Superintendent of the Rockwood Hospital for the Insane, an examination was made of the proposed changes in the sewage disposal system for the institution at Rockwood. The plans were not recommended for adoption owing to the fact that a system of the kind suggested required considerable manual labour in and about the beds and that, in addition, considerable supervision would be needed. Both these requirements are objectionable in dealing with institutional plants, such as at the hospital at Rockwood.

An alternative scheme was suggested, involving the use of an automatic distributor of the water-wheel type. Upon further request of Mr. Rogers, plans were prepared covering the changes proper for the construction of such system: these were made in the office of the Provincial Board of Health. The work called for by these plans involved an estimated expenditure of $5,000, the major portion of the expenditure being for the extension to the existing building and for the distributing apparatus. The plans were accepted and the work is now under construction and will be in operation about June 30th, 1914.

Guelph, March 31st.

In company with the Medical Officer of Health and several members of the Water Works Commission, an examination was made of the sanitary conditions surrounding the gravity supply pipe feeding to the water works pump house. Arising out of the growth of the sub-division at St. Patrick's Ward, considerable pollution was anticipated in the neighborhood of the pipe line which is laid in a shallow trench through this district. After going over the situation, two measures of protection were suggested—one being to lay a duplicate pipe line for this portion, carrying it nearer the river bank and away from possible dangers of local pollution; the other measure was to lay the sewers considerably deeper than the invert of the pipe line so that no seepage from the sewers could drain thereto. I am of the opinion that if the sewers are laid deep very little pollution will gain access to the neighborhood of the pipe line.

Cornwall, May 5th.

In company with Dr. Moloney, an examination was made of the existing sewerage conditions at Cornwall, with special reference to the location of a sewage disposal site; the water works and source of supply were also examined. The

conditions existing in the St. Lawrence River at this point indicate that considerable pollution must be present during the summer when navigation is at its height. The typhoid statistics for Cornwall, while showing no serious outbreak, indicate that there is considerable prevalence of typhoid. Treatment of the water supply, either through filters or by chlorination, seems advisable from the evidence we now have.

Alexandria, May 6th.

In company with Dr. Moloney, Mr. Magwood, the Mayor and other officials of the municipality, an examination was made of the water supply of Alexandria. The present source of supply is from the River DeLisle. This river runs through a long stretch of agricultural land most of which is at the present time serving as pasture; a great many cattle were observed in the stream, which is a shallow one. The request for an inquiry arose out of the fact that the present source of supply is hardly adequate with the increase in consumption which is taking place. A dam is used to conserve the present supply at the pump house. In summer the reservoir gets very low and through the action of the sunlight on the shallow water permits of heavy algal growths which impart a taste and color to the water. Very little of the town water is used for drinking purposes, although it is accessible on all premises. The water supply is unquestionably subject to pollution and might at any time give rise to a serious epidemic if excretal matter of infectious character found its way into the unprotected stream above the water works intake. No pretence is made to protect the watershed either by policing it or by acquiring rights to fence it off.

A visit was made to Loch Garry to discover the condition of the water as to whether it would serve as a suitable source of supply. Loch Garry is subject to considerable rural drainage and its waters, although of good color, contain a large amount of decayed organic matter in suspension. Filtration would, in all probability be required to render this water suitable for domestic use. Another scheme and one which seems to be best suited to the needs of the municipality (if practicable) is to obtain the water from wells located in sandbars above the mill dam in the DeLisle River.

The present source of supply is altogether unsanitary, and a new supply is certainly needed. Filtration of the water from Loch Garry is one feasible solution of the problem; the wells may be another.

Ottawa (Perley Home), June 6th.

Upon request of the Ottawa Land Association and of the City of Ottawa, a visit of inspection was made to the proposed site for the sewage disposal plant for the Lady Grey Sanatorium at Ottawa. The land available for the sewage disposal area, between the sanatorium and the creek, has very little surface and is underlaid by impervious rock. It seemed advisable to recommend the use of a built-up area on this tract for sewage disposal purposes, although there was a possibility that the tile could be laid within the hospital property in the north-west corner near the new Annex. For the convenience of the parties interested the following proposals were submitted:

(1) That 23 rows of 4 in. tile, 100 feet long, 18 in. apart, will be all that is required.

(2) That these tile be fed from a syphon chamber of not more than 170 cubic feet capacity and not less than 100 cubic feet capacity between syphon discharges.

(3) That a sludge tank be arranged to provide storage for three cubic yards of sludge and that it be cleaned twice a year and have in addition a flow chamber capacity of 100 cubic feet, the flow to be suitably baffled to prevent undue agitation.

(4) That the tile be laid with 6 in. of gravel surrounding them, 18 in. of sand or loam underneath and from 2 ft. 6 in. to 3 ft. of earth and sand on top.

(5) With regard to the matter of the city supplying sewerage convenience to the hospital, I think we should not tie the city up to any definite route—simply ask them to proceed with it at their earliest convenience along the most desirable route.

Schreiber, July 21st.

In company with Dr. Wodehouse, a visit was made to Schreiber to examine into the possibility of installing a sewage disposal tank. A suitable site was selected and a design was suggested to the C. P. R. Engineer who was acting on behalf of the town. The tanks have since been installed, and from our latest reports are operating satisfactorily.

Kenora, July 26th.

In company with Mr. Hay, Town Clerk, a visit was made to the water works and examination was made into the conditions affecting the proposed sewerage scheme.

The present source of supply for the town water works is not above suspicion, and probably is frequently subject to pollution arising from the Indian School and from summer resident pollution on Lake of the Woods. It was recommended that the town proceed with the installation of a chlorination system for disinfecting the water supply and also that they instal a Venturi meter for measuring the quantity of water pumped. Electrically-driven centrifugal pumps are used at Kenora and operate continuously to maintain the proper pressure on the town system. No record is being kept of the amount of water pumped; this seems advisable, in view of the fact that breaks in the mains and other factors which might seriously affect a fire cannot be detected except by unusual conditions promoted at the surface of the ground by reason of a break; these conditions at the surface are not always evident. Where a meter of the recording type is used, such breaks and serious leaks are very readily detected and repairs can be made before any disastrous results are experienced.

Stratford, August 13th.

In company with Dr. McNally, and upon instructions from Dr. McCullough, arising out of the threatened litigation against the City of Stratford *re* the pollution of the River Avon, a visit was made to that place. The findings in connection with this investigation were as follows:

(1) Indifferent management of the sewage disposal works has existed, and, when convenient, raw sewage is bye-passed directly into the river.

(2) The present pumping equipment is inadequate, both as to size and equipment.

(3) The sedimentation tanks are in a bad state of repair and will need replacement in four or five years. The design of the tanks is bad and the sludge is being constantly thrown into suspension by gas from the bottom.

(4) Under the existing arrangement, the sedimentation tanks cannot be cleaned without sending the sewage into the river; this operation takes from five days to two weeks.

(5) The humus from the sprinkler beds is not intercepted in any way and is carried to the creek with the effluent, creating a black sludge therein; this sludge destroys vegetation on account of producing anaerobic conditions in its vicinity and creates a nuisance in shallow parts of the stream.

The following modifications were suggested as being necessary to fulfil the requirements of the Public Health Act and to prevent successful litigation:

(1) Improved pumping equipment, making the pumps more nearly automatic, with the addition of an auxiliary which would provide power in the event of the electric pumps failing and which would also be available during storms to assist the electric pumps during maximum storm water flow, the pumping equipment to be of a capacity adequate to handle the maximum flow of sewage.

(2) The construction of a humus tank of the double chamber type with a capacity for at least 20 minutes storage at maximum hourly flow from the sprinkler beds.

(3) Replacement of a portion of the present sedimentation tanks by a modern double chamber type, of capacity for 30 minutes at maximum flow, the sludge chamber arrangement to be such that sludge could be removed without interfering with the operation of the tanks; the tanks to be provided with grit chambers and a screen.

(4) A chlorination plant suitably heated to be provided for the treatment of the sprinkler effluent in order to protect the cattle using the stream lower down from undue presence of pathogenic organisms. This latter modification would assist very materially, in the event of a storm or other untoward circumstance, in the handling of raw sewage and would permit of its being byepassed for short intervals subject to heavy chlorination from the settling tank into the stream.

I am pleased to further report in this connection that the City of Stratford has submitted plans for the suggested modifications and anticipate the construction of a portion of these works in 1914.

Seaforth, August 14th.

In company with Dr. McNally, a visit was made to the municipality of Seaforth to examine into the question of water supply and sewage disposal.

The town, having involved itself in rather heavy expenditures in connection with the construction of a brick pavement on the main street, did not seem at all anxious to take up the question of domestic water supply. There exists at the present time a fire protection system over part of the town, the source of supply being a small stream flowing through the town. It appears, from the experience of neighboring municipalities, that there is plenty of artesian water beneath the town, not likely lower than 200 feet. Seaforth has about 2,000 inhabitants and requires a proper water supply. Several cases of typhoid have been occasioned in the municipality by reason of pollution of some of the shallow wells. The town should employ an engineer to make the necessary tests for artesian water and to prepare a report upon the cost of a sewerage scheme.

Sudbury, August 17th.

An examination was made of the proposed site for the sewage disposal plant at Sudbury. The suggested location of the plant about 1,000 feet from the railway tracks and in a low area subject to floods during the spring months was not approved of. Upon examination it seemed advisable to change the location of the disposal works considerably, involving the construction of a pumping station. The change was recommended in view of the fact that during the spring freshets, under the original arrangement, the main trunk sewer would be backed up several thousand feet, which would probably occasion a considerable deposition of solids in the sewer; under the suggested arrangement this should not occur.

Forest, August 22nd.

Upon request of Dr. Bentley, a visit was made to Forest for the purpose of examining into the nuisance created by the effluent from the cannery located there, and to advise further measures for its purification. It appeared upon investigation that the tank at present installed is both inadequate as to size and faulty in design, inasmuch as both influent and effluent pipes are placed so low that storage is practically impossible. New tanks were suggested at a lower level and of a sufficient capacity to provide for proper sedimentation of the waste liquors.

The present method adopted by the cannery for handling tomatoes is very excellent and practically eliminates the possibility of serious nuisance from this source. Wastes during the canning of peas are the cause of their present trouble.

The reconstruction of the disposal works has been undertaken and will be completed before the season of 1914.

Chatham, August 23rd.

In company with Dr. Bentley a visit was made to the municipal water works and to the abattoir.

It was suggested that the quantities of hypochlorite administered to the water supply should be increased to a minimum of .35 parts of available chlorine per million. While quantities less than this appear to have been effective in other centres, yet where the contact period is as short as it is at Chatham, the use of smaller quantities is not advisable. It is doubtful whether smaller quantities afford any further protection than that arising out of the use of the filter.

The design of the sedimentation tank at the abattoir was discussed; a modification was recommended by means of which a better precipitation can be obtained in the chambers. Under the existing arrangement, the flow is checked by baffles and rises to the secondary chambers from an opening placed immediately at the bottom of the tank. Currents in the vicinity of this opening practically prohibit sedimentation and cause the material in suspension to be carried with some velocity into the next chamber. A considerable amount of masses of fat and other material in suspension were observed flowing over the effluent weir. This, it is believed, will not happen with the suggested modification. These changes have since been made.

Niagara Falls, August 29th.

Upon instructions from Dr. McCullough, subsequent to an outbreak of typhoid fever, an examination was made at Niagara Falls for the purposes of installing a temporary chlorination plant.

The water supply of Niagara Falls is obtained from the Ontario Power Company's flue, a short distance above Victoria Park. The water at this point is subject to periodic contamination arising mainly from two sources—the Welland River, or Chippawa Creek as it is sometimes called, and the sewage from Buffalo. While it is very difficult to show by examination that the sewage of Buffalo actually reaches this water supply, yet from the evidence obtained by the work of the International Joint Commission and from the manner in which the ice comes down the river in the spring, it seems quite possible that periodically the sewage of Buffalo in part reaches this intake. The character of the outbreak seemed to indicate that the infection did not extend over possibly more than one day. A great many cases occurred throughout the Province other than at Niagara Falls which were traced back to the Niagara Falls infection. Owing to the possibility of frequent recurrences of such conditions, it was deemed advisable to instal a chlorination plant. The necessary temporary apparatus was purchased and installed by the corporation on August 30th and was in operation that night. More permanent equipment seems advisable, with the possible addition of large sedimentation tanks to permit of equalization after the administration of the disinfecting agent to eliminate taste. It must be borne in mind in connection with the present condition of the water supply that a severe outbreak of typhoid may recur at any time and infective material be distributed all over the Province, if some adequate protection is not resorted to. This is one of the infective centres referred to on page 47.

Perth, September 3rd.

An examination was made at Perth in connection with the water works system. Dr. Dwyre very kindly placed himself and his motor at my disposal in the forenoon. The watershed draining to the present source of supply, The Tay River, is entirely unprotected and there is no question but that a considerable amount of pollution is now reaching the river. Fortunately, absence of typhoid fever from the country and from the watershed has prevented any noticeable outbreak due to their lack of protection. The water contains a considerable amount of suspended matter and has some color. It is altogether advisable that mechanical filters be installed to protect the supply. To meet the fire underwriters' requirements and to keep down the capital cost of the filters, it is possible that the installation of a clear water reservoir would be an economic advisability. Such a reservoir could in time of fire act as an auxiliary supply, being cross-connected to the pump suctions. Such a reservoir is filled by the excess water passing from the filters in time of low domestic consumption.

Orillia Hospital for Feeble-Minded, September 12th.

An inspection was made of the springs serving as source of water supply for this institution in order to determine the probability of contamination from various agencies. The open reservoir fed by springs receives in addition several surface streams which are subject to considerable pollution arising from cattle who use them during the summer months as watering places. The gathering area is very hilly and it is the springs in the low ground which supply water to the cattle pasturing on this area. It was recommended that either the two adjoining properties in the neighborhood of the springs be acquired and the cattle removed, or that the waters of the surface feeders be diverted past the

reservoir by means of a suitable ditch. It was impossible to determine just what was the source of supply to the present reservoir, but one would judge from the quantity of the water flowing away that it received considerable water from springs other than the surface feeders. The reservoir contained considerable organic growth at that time, and it was suggested that this be removed as soon as convenient, as its presence might give rise to disagreeable taste and odors.

To overcome the slight amount of pollution in the supply under present conditions the use of three ounces of bleaching powder for each tank of 3,000 gallons was recommended, and is now being adopted.

Bowmanville, September 22nd.

Upon request of the Department of Hospitals and Public Charities, a visit of examination was made to the sewage disposal plant for the hospital at Bowmanville. The hospital lies on the outskirts of the municipality and has at the present time no sewerage facilities. The system which had been installed sometime previous was a cesspool constructed with a tight bottom and cypress sides; apparently, the only way the sewage could escape from this tank was by overflowing or by percolating through the soil from a breather which was placed on one side. Its operation was interrupted by the formation of a considerable mass, probably eight inches thick, of floating matter which prevented the escape of the liquid and backed up the feed pipe in such a manner as to overflow the syphons in the hospital itself. As an emergency aid, ditches had been dug and the sewage was being received into basins placed near the tank in the garden belonging to the institution. As a temporary expedient, and with the ultimate intention of connecting with the town sewerage scheme, which was being rapidly advanced in the direction of the hospital, sub-soil drainage was recommended and in connection with this it was suggested that the tile be laid rather shallow in order to take advantage of the deep layer of humus which overlaid a rather stiff clay.

Government Clay Products Plant at Mimico, September 27th.

The disposal area which was installed to take care of the residences (60 people) has been in use for some time and showed serious saturation arising out of the fact that underdrainage had not been provided. The disposal area is placed in a low part of the property which has no sub-surface drainage. The only possible escape of the sewage being either by lateral filtration near the surface or by evaporation from the surface. The quantity of sewage being handled was such as to make these methods impracticable. Saturation had begun to take place some weeks before my visit.

The only method which could be recommended as ensuring efficiency was that of deepening the bed to provide greater filtering media and to carry the effluent away by means of underdrains laid below the bed in suitable trenches filled with sand to connect with the bottom of the bed.

The underdrains should be carried to a sump-hole, the water from which could, by installing pumps, be either used in the manufacture of bricks or discharged to a ditch running in the immediate vicinity. Unfortunately, the ditch cannot be fed by gravity owing to the fact of its level being considerably higher than the level of the underdrains.

Ottawa, Gatineau Lake Scheme. October 4th.

In company with Dr. Amyot, Dr. Lomer, Medical Officer of Health of Ottawa, and Mr. Race, City Analyst, examination was made of the catchment area for the proposed Ottawa City water supply from Thirty-one Mile and Pemachangan Lakes. After viewing the catchment area, the report of Sir Alex. Binnie was examined for the information relating to the area and probable quantities available. The information in connection with this scheme is, in my opinion, complete enough to base a report upon, plans having been prepared showing the extent of the catchment area and the course of the pipe line from Thirty-one Mile Lake to Ottawa, with sufficient surveys to indicate the features in connection with this pipe line. Sir Alex. Binnie and his assistant, together with the Government engineers who located the pipe line and who made the surveys in connection with the pipe line, are competent engineers. The information which Sir Alex. Binnie used in reference to precipitation seems most conservative, and is in my opinion sufficiently complete to show the advantages of this scheme. The question of capital expenditure appears to occupy a somewhat more prominent position than should be afforded it when considering the annual maintenance charges which do not evidence such disproportionate costs between the filtration scheme and that of the gravity scheme.

There is no question from the bacteriologic evidence in our possession but that the Ottawa River is seriously polluted in the neighborhood of the intake, and of any intake that could be placed in the Ottawa River in the vicinity of the City of Ottawa. This pollution extends as far as Aylmer by examination, and in all probability can be found higher up than that.

It is probable, judging from experience in other centres, that the river water can be treated so as to render it non-disease producing. One must, however, bear in mind that the raw water is seriously polluted and that interruption in the operation of a filtration plant might precipitate an onslaught of typhoid fever and other water-borne diseases. Bearing these facts in mind, the water supply such as was available from the Gatineau Lake scheme appealed very strongly to me, as the scheme was one in which the water was entirely free from pollution or possible sources of typhoid fever and one in which all protection from storage could be taken advantage of. The water itself was of exceptionally good character, and was one which in all probability would at no time require filtration. The Provincial Board of Health of Quebec, informed me that in event of the scheme being adopted it was their intention to have the City of Hull avail themselves of this pure water and abandon their present polluted supply derived from the Ottawa River. From the standpoint of public health, this is a further advantage in connection with the Gatineau Lake scheme. I have no hesitation in recommending this scheme for approval by the Board in preference to the use of the filtered Ottawa River water. In the one we have every assurance that it is not the source of water-borne disease: in the other we must always hesitate to eliminate it as one of the major factors in the event of the presence of typhoid fever.

I am including herewith the report of Sir Alexander R. Binnie:—

OTTAWA WATER SUPPLY FROM THE GATINEAU LAKES.

REPORT BY SIR ALEXANDER R. BINNIE.

Gentlemen,

In accordance with instructions received through the High Commissioner in England, I visited Ottawa in company with Mr. Houston in the month of February this year in order to advise you with regard to the steps which should be taken to improve

the water supply of the City. After careful consideration we came to the conclusion, which is embodied in our report dated the 10th of February, 1913, that you should abandon the Ottawa River and obtain your supply from an uncontaminated source such as is afforded by the lakes lying between the Gatineau and Lievre Rivers. We visited Thirty-one Mile Lake and samples were taken which showed that if this water could be secured the City would be in possession of one of the finest sources of water supply known to us.

Owing to the absence of contour maps showing the levels of the various lakes and the configuration of the country it was impossible at that time to prepare any definite scheme or to give a proper estimate of cost. I advised, therefore, that proper surveys should at once be undertaken which would permit of definite conclusions being arrived at.

It was accordingly arranged that the Dominion Government should undertake the necessary survey and that I should send out a representative who would be able to direct the surveyors so that the information necessary to prepare a scheme of water supply from the Gatineau lakes should be obtained.

In accordance with this arrangement, Mr. Legg left England on the 18th of April, and has spent six months investigating on the spot and obtaining the information which I require. In accordance with the resolution passed by the City Council on May 5th, I was requested to visit Ottawa as soon as the necessary surveys, etc., were completed in order to furnish you with my definite recommendations. Owing to an operation which I had to undergo on the 15th of July, involving the amputation of the left leg, it was impossible for me to make this contemplated visit. Mr. W. R. Tickell, who is an engineer of great experience in these matters, was to have accompanied me, and as I was unable to come myself I suggested that my son and partner, Mr. W. J. E. Binnie, who has also had wide experience in waterworks engineering, should go out instead of me. This suggestion was adopted by the City Council and, in accordance with instruction dated the 25th of July, these two gentlemen arrived in Ottawa on August 29th, at which date surveys, etc., had been sufficiently advanced to permit of the preparation of the scheme which would be accompanied by full and definite particulars. These two gentlemen, together with Mr. Legg, have made a thorough investigation of all the sources of water supply which will be dealt with, and have made a detailed examination of the proposed routes for the aqueducts, including the service reservoir, and have determined the site of all the necessary works.

The information obtained has been sent home to me for my consideration and I shall now proceed to deal with the whole question.

Provision Which Should be Made for the Future.

The present rate of water consumption in Ottawa is very high, being about 175 gallons per head per diem, calculated from the pumping records after allowing 6½ per cent. for the slip of the pumps.

From an examination of the statistics kept by your Water Engineer, I have come to the conclusion that not more than 59 gallons per head per diem is actually used, and that the rest is wasted by leaky pipes and house fittings.

The average rate per head in other Canadian cities that have a population of 50,000 persons or over is as follows:—

(Report of Commission of Conservation, 1912.)

City.	Population.	Consumption per diem.	Rate per hundred per diem.
Montreal	580,000	67,800,000	117 gals.
Toronto	425,000	42,132,000	99 "
Winnipeg	175,000	8,000,000	46 "
Vancouver	125,000	17,000,000	136 "
Hamilton	85,000	10,500,000	123 "
Quebec	75,000	10,000,000	134 "
Victoria	50,000	4,000,000	80 "
	1,515,000	150,432,000	105 approx.

The consumption varies from 136 to 46 gallons per head per diem and is lowest in the two cities, Winnipeg and Victoria, where water is sold by meter and the consumers have, therefore, to pay for all the water which is wasted in the house.

The average rate of consumption per capita is six times that of London, but the conditions are such as to render it necessary to make a very ample provision. By a thorough system of inspection and vigorous enforcement of by-laws for the prevention of waste, coupled with a thorough examination and repairs of the existing distribution system, I am of opinion that the water supply per capita can be reduced in Ottawa to 100 gallons per head per day.

On this assumption I have considered the capability of the various sources of supply to provide 25,000,000 gallons per diem, or sufficient for 250,000 persons, keeping in view that the source of supply should be ample to provide for a possible future population of 750,000 persons.

An experience gained in the study of this particular subject extending over 50 years of professional life has shown that on the introduction of a gravity supply the efforts to reduce waste have been relaxed. The reason of this is obvious; as the water comes down by gravity, and there is, therefore, no apparent economy in attempting to reduce waste. The time will then rapidly arrive when the limits of the first instalment of a gravity scheme are nearly reached, and in order to attempt to postpone the heavy additional financial burden represented by the introduction of the second instalment efforts are made to reduce waste. These efforts, though to a certain extent successful, are not sufficient to get down the waste, and the inevitable introduction of the additional water supply is brought about by a rapidly increasing population much sooner than should have been the case. The reduction of waste and leakage in a large city like Ottawa is not an undertaking which can be carried out in a short time; it takes years of careful work to bring it about and unrelaxed attention to keep the consumption at a low figure.

I wish, therefore, to place on record that it is, in my opinion, most urgent that the City should use every effort to bring down the rate per capita to a reasonable figure so as to enable a water supply of 25 million gallons per diem to serve a population of 250,000 persons and postpone in that way the time when it would be necessary to augment the supply.

Gatineau Lakes.

A preliminary examination indicated that there were two possible schemes which would be found to afford sufficient water to meet future requirements.

These schemes are:—

1. To take water from Thirty-one Mile and Pemachangan Lakes.
2. To take water from the McGregor Lakes.

These sources of supply are shown on the general map which accompanies this report.

Thirty-One Mile Lake and Pemachangan Lake.

These two lakes are situated on the east bank of the Gatineau River, at a distance of about 40 miles to the northward, measured in a straight line from Parliament Hill to the south end of Pemachangan. The surrounding area of land which drains to these lakes is dotted with numerous other smaller lakes, but the above mentioned are the only lakes of any importance and extent.

Quantity of Water Which can be Obtained From This Source.

The quantity of water which can be derived from any given drainage area depends on three factors:—

1. The extent of the drainage area, which in this case would be 150 square miles approximately;

2. The quantity of rain or snow which is annually precipitated on that drainage area; and,

3. The proportion of the precipitation which flows from the ground and can be collected, known as the run-off.

Rainfall.

There are no rain gauges within the drainage area, nor within a long distance from it, the nearest gauges being situated at Lucerne and Perkins Mill, about 25 miles to the southward. I have not been able to obtain reliable information with regard to the former gauge, but the readings at Perkins Mill, which appear to have been carefully kept, indicate a higher rainfall during the two years commencing May, 1911, when the gauge was established, than that at Ottawa. The average rainfall registered at the Experimental Farm between the years 1892 and 1912 inclusive amounted to approximately 35 inches per annum. The period of observation is too short for fixing a true average and comparing this gauge with the gauge whose records were published by the Department of Marine and Fisheries in 1906, and which has been kept since 1875, it would appear that the true average is about 34.2 inches. The total rain and snow re-

corded at Perkins Mills during the year 1912 amounted to 44.57 inches as against 41 inches at the Experimental Farm. The true average at Perkins Mill would, therefore, appear to be

$$34.2 \times \frac{44.37}{41} = 37 \text{ inches approximately.}$$

These figures appear to show that the rainfall is higher as we go northward. Although the records are too scanty to justify any figures based on such an assumption, at the same time I am of opinion that an average precipitation of 37 inches per annum may be taken for this drainage area, taking into account its elevation and general character.

Run-off.

There is very little information available regarding the percentage of run-off from rainfall in the vicinity or indeed in any part of Canada, but certain observations were made in connection with the Georgian Bay Ship Canal project which are, to some extent, applicable. These are fully dealt with in the Sessional Paper 19-A of the Report. The area on which the observations were made was the drainage area of Lake Talon, near the head of the Ottawa River. Its latitude is practically the same as that of Thirty-one Mile Lake, whilst in the longitude it is only some 150 miles west and the elevation of Lake Talon is about 100 feet higher than Thirty-one Mile Lake. The following description of the nature of the drainage area as given in the Report, page 197, would apply equally well to the drainage area of Thirty-one Mile and Pemachangan:—

"Almost the entire drainage area above the outlet of Lake Talon is heavily wooded. In the vicinity of Bonfield and Rutherglen and in one or two isolated places there is some farming, but only to a very limited extent, and probably not more than three per cent. of the entire drainage area is cleared. Some of the area not now cultivated might be improved in the future, but most of it is not suitable for cultivation and it is unlikely that any material change will take place in the character of the watershed."

The area thus described consisted of a total of 342 square miles, about 24 of which were open water and 318 land. For the purposes of investigation, 6 rain gauges, two evaporation gauges, and several river gauges were fixed, which were read daily from April, 1905, till November, 1906. The results are given in Tables 4 and 5, pages 218 to 239, and plate 29 of the Report. The figures show that for the whole period of 21 months during which the observations were continued, 51.6 per cent. of the rainfall flowed off, and that for the twelve months, March, 1905, to February, 1906, 57.1 per cent. flowed off, whilst for the twelve months, November, 1905, to December, 1906, 44.9 per cent. flowed off. It would appear that the percentage of run-off given represents the run-off from the whole catchment area of land and water and that the annual loss by evaporation was about 15 inches. This figure is confirmed by the records of flow of the Ottawa River which have been kept at Besserer's Grove, about 9 miles below Ottawa, since the year 1867, and which are also published in the Georgian Bay Canal Report. The evaporation from the water surface of Lake Talon is given in the table on page 126, and the following are the figures:—

Evaporation at Surface of Lake Talon.

	Total amount for the month.		Inches. Mean of 2 Years.
	1905	1906	
January	....	....	....
February	....	....	....
March	....	....	....
April	.360	.400	.380
May	2.000	2.608	2.304
June	2.563	3.420	2.991
July	3.065	5.233	4.149
August	2.776	4.091	3.433
September	1.733	3.686	2.710
October	1.500	1.912	1.706
November	....	.745	....
December	....	....	....
	13.997	22.095	18.045

The results of these investigations may, I think, be fairly applied to the catchment area of Thirty-one Mile and Pemachangan Lakes and show that we may safely assume an annual evaporation of about 15 inches from the ground surface and 18 inches from the water surface, or, seeing that the area of water to land is about 1 to 5, an average evaporation figure of 16 inches may be taken as applicable to the whole drainage area of Thirty-one Mile and Pemachangan Lakes.

Having now arrived at a figure for the average annual rainfall and the loss by evaporation, it remains to consider those periods when the rain will be less than the average. When adequate storage is provided it is not necessary to consider the driest year, as the storage in the reservoir will make up for the shortage of several years. The usual English practice is to take the reservoir as being sufficient to equalize the rainfall of the three driest consecutive years, which is found all over the world to be about 80 per cent. of the mean annual rain fall. The available run-off which can be depended upon on this basis is, therefore, as follows:—

Average rainfall	37	inches.
Deduct 1-5	7.4	"
Mean of 3 driest consecutive years	29.6	"
Deduct for evaporation	16.	"
Available run-off	13.6	"

Discharge from the Drainage Area.

Taking 13.6 inches of rain on the catchment area of 150 square miles, the average yield would be during the three driest consecutive years approximately 81 million gallons per diem, and would, therefore, be ample to meet the requirements of a population of 750,000 persons.

Quality of the Water.

Apart from bacteriological or chemical examination the character of the water can be very largely predicted from an examination of the drainage area. Sketches are given herewith of Thirty-one Mile Lake, Pemachangan and Long Lake, which show the general character of the scenery. The rocks are gneiss and crystalline limestone and are apparent at or near the surface over almost the entire drainage area which is covered with trees and undergrowth, very little clearing having been done, the entire resident population amounting to only 130 persons, or less than 1 to the square mile. In addition to this resident population there are a certain number of summer visitors and lumbermen, who are at work round the lake in the early summer months. The shores shelve rapidly into deep water almost all round the lakes and the islands with which they are dotted. No soundings have yet been taken except at certain points, but we are informed that there are places in the lakes over 200 feet in depth. The drainage area has now been examined at a great number of points and has been found free from peat or other surface deposits liable to discolor the water, and the total area of swampy ground is insignificant. It might be expected that water flowing from such a drainage area would be of exceptional purity, and such is the case. This water having been under observation during the whole of this year when it has always proved to be bright and clear, the bottom being plainly visible at great depths. About the beginning of September certain organisms called Rhysopods make their appearance in all the lakes examined, except some of the small ones, and disappear in a short time. In appearance they resemble minute sea urchins, but are plainly visible to the naked eye, and are, in fact, of such dimensions as to be readily removed by fine mesh screens. It will, therefore, be necessary to provide such screens at the outlet, both to prevent these organisms and fish from entering the pipe. If steps are taken by the city to prevent contamination in the future by human pollution there will never, in my opinion, be the slightest necessity to filter this water, and should Ottawa adopt these lakes as a source of supply one of the finest water supplies in the world would be secured.

Method of Collecting and Storing the Water.

There are four lakes which form a chain stretching approximately north and south. Commencing at the north is Mitchell Lake, a small lake which discharges through a narrow gorge at its outlet into a channel which finds its way into the Gatineau. This lake has a surface area of .7 square miles, and water level in September was 523 feet above datum. It receives the entire discharge of Thirty-one Mile and Pemachangan,

and a narrow rocky gorge already referred to forms an admirable site for a dam. The next in the chain towards Ottawa is Thirty-one Mile Lake which is about 18 miles in length, with a water area of 18 square miles, the water level this summer being about 530 feet above datum. Immediately to the south, and separated by a narrow neck of land, lies Pemachangan, with a water area of 6 square miles and a length of about 5 miles, the water level this summer being about 552 feet above datum. Crossing the height of land to the southwest of Pemachangan we come to Long Lake, having a length of about 1¼ miles, and a water area of about one quarter of a square mile. The distance between Pemachangan and Long Lake is about 3,000 feet, and the water surface of Long Lake is 561 feet above datum. It is proposed to tunnel through the ridge between Pemachangan and Long Lake and by means of the dam at the outlet of Mitchell Lake to bring all the lakes to one level, namely, 570 feet above datum, and to start the aqueduct to Ottawa from the south end of Long Lake. This would mean raising Mitchell Lake 47 feet, Thirty-one Mile Lake 40 feet, and Pemachangan Lake 18 feet. The contour surveys to determine the top water area at this level are not yet completed, but it may be roughly assumed that the total top water area of the lakes when brought to this uniform level of 570 feet above datum will increase to about 35 square miles in area. One foot difference in level of a water surface having an area of 35 square miles represents about six thousand one hundred million gallons, and 18 inches would give a year's storage of a daily flow of 25,000,000 gallons; 3 feet would give sufficient storage for 50,000,000 gallons per diem, and 4 feet 6 inches sufficient for 75,000,000 gallons per diem. The maximum variation in water level would, therefore, be small.

Dam at Mitchell's Lake.

This dam would be designed so as to overflow at a height of 570 feet, the total contents of masonry to this level being estimated at about 9,100 cubic yards. Timber is being cut in the forest surrounding Thirty-one Mile Lake, the logs being floated down to the Gatineau by way of Mitchell Lake and the channel below that Lake. As the time will not arrive for many years when it might become necessary to consider the acquisition of these lumber rights in order to conserve the whole of the available water for the supply of the city, I have based my estimate on the assumption that those rights are not now acquired and that provision will be made for the necessary regulating sluice and chute for passing the logs from the lake into the stream below.

Clearing Ground Which Will be Submerged.

I have assumed in the estimate that the area now surrounding the lake which will be submerged when the water rises will be cleared, such timber as saleable being removed, and the remainder, including the undergrowth, cut and burnt. This does not include grubbing up the roots which will be charred, as I do not consider charred roots will have any effect on the quality of the water.

Rate of Filling of the Lakes up to the Top Water Level, and Steps to be Taken to Afford Immediate Supply.

It has already been stated that the dam would be constructed so as to raise the level of the lake to 570 feet above datum, which means that Thirty-one Mile Lake would have to rise 40 feet, and Pemachangan 18 feet. Owing to the enormous area of Thirty-one Mile Lake it would take five or six years before this lake would rise even to the level of Pemachangan, that is 22 feet, and ten or twelve years before it reached the final level of 570 above datum. It is obvious that the scheme should be so laid out as to enable water to be brought forward to Ottawa as soon as the aqueduct and service reservoir can be completed, which can be effected in the following manner:

Pemachangan and Long Lake to be First Drawn Upon.

Pemachangan and Long Lake have a total drainage area of about 41½ square miles and would yield on the basis of a run-off of 13.6 inches about 22½ million gallons per diem, or sufficient for the needs of the City for a good many years. The level of Pemachangan Lake varies between about 554 and 552 feet above datum, and the Lake is separated by a narrow neck of land known as Point Comfort, from Thirty-one Mile Lake which is about 30 feet lower in level. This neck of land acts as a natural barrier which retains water at the high level in Pemachangan, and is traversed by a narrow gorge through which the water is discharged into Thirty-one Mile Lake. This gorge is blocked by a wooden dam provided with sluices and the fall of water from one lake to the other is utilized for a sawmill. Water also finds its way into Thirty-one Mile

Lake from Pemachangan through debris overlying the rock filling the bottom of what no doubt was at one time a valley of discharge from one lake to the other. I was informed that there were underground fissures connecting the two lakes, and the measurements which have been taken this summer show that when the water level in Pemachangan stood at 554 feet above datum, that amount of water which got through this debris or surface fissures in the rock amounted to approximately 8,000,000 gallons per diem; but when the water level in the lake had fallen to 552 datum the discharge was very small indeed, showing that the water was really finding its way from one lake to the other through a comparatively shallow channel. Of course, there may be some deep underground fissures which would be incapable of detection, but there is no doubt that any water lost by them is insignificant, provided the present level of the lake is not materially altered. I should, therefore, propose as one of the first steps to be taken to open a trench across the old channel and fill this concrete so as to cut off the water now leaking away through the debris when the water level is raised to 554 feet above datum, and to make a water tight dam in lieu of the existing leaky dam which holds up the water for the mill. These works would enable the water to be retained in Pemachangan Lake and the City could draw upon that lake as soon as the aqueduct was completed. The present water area of Pemachangan is about 6 square miles, and 5 feet in depth on that area would represent that total storage required for the first instalment of 25,000,000 gallons per diem. Assuming that the minimum draw-off level was to be 549 feet above datum or 3 feet below the present level, the maximum level at which the water would overflow would be 554 feet above datum. Although in this way the storage required for the first instalment would be provided, it must always be borne in mind that Thirty-one Mile Lake will take years to be brought up to the level of Pemachangan, and it must not be forgotten that on the basis of my figures the Pemachangan area will not quite yield sufficient for the first instalment of 25,000,000 gallons or as much as the aqueduct will carry, and the sooner Thirty-one Mile Lake is brought up in level the better.

The dam at the outlet of Mitchell's Lake should, therefore, be proceeded with as soon as the necessary arrangements could be made, so that Thirty-one Mile Lake can be gradually raised to such a level as to flow towards Ottawa by means of the aqueduct. I have, therefore, included in the estimate for the supply of 25,000,000 gallons, the cost of the dam at Mitchell's Lake, and also the necessary clearing to bring Thirty-one Mile Lake and Pemachangan Lake to the level of 570 feet above datum when storage will be provided for the full yield of the drainage area or 81,000,000 gallons a day.

Tunnel Between Pemachangan and Long Lakes.

To bring the water of Pemachangan into Long Lake, from which the aqueduct would start, will necessitate constructing a tunnel through the height of land between the two lakes, a distance of about 3,000 feet, as already pointed out. This tunnel should be made about 7 feet internal diameter so as to permit of the whole available yield, namely, 81,000,000 gallons per diem being passed through into Long Lake without appreciable loss of head.

The best location for the invert of the tunnel would be about 6 feet below the present level of Pemachangan or at about 546 feet above datum, 24 feet below top water level when brought up to 570 feet above datum.

This tunnel would terminate at each end in covered shafts, the water entering the shaft at the inlet end and leaving the shaft at the outlet end well below the water level of the respective lakes.

In this way there would be no danger of the water in the tunnel freezing, even if the lakes were drawn down to the level of 549 feet above datum, which is the minimum draw-off level, during the construction of Mitchell's dam and during the period while the lakes are filling up to 570 feet above datum.

In order to enable the tunnel to be driven from an open face to obviate the necessity of pumping any water which may be met with, and also to facilitate the construction of the outlet works, it is proposed to draw down Long Lake during construction in the manner to be presently described.

Works at Long Lake.

Long Lake varies in depth from about 20 feet to 50 feet, being shallow towards the north end and deep towards the south. This lake, like Pemachangan, is formed by a natural barrier and the water issuing from it passes over this barrier by means of a series of small falls and cascades to the valley below, dropping 50 or 60 feet in a short distance.

A short cutting through this barrier will, therefore, enable the water to be drawn down 20 or 30 feet without any difficulty.

The shores of the lake are steep and rocky, but at times during and after windy weather the sediment in the bottom is stirred up by wave action. This action does not extend to any great depth, probably not much below 10 feet. It is, therefore, proposed to remove the sediment, logs, etc., when the lake is drawn down so as to prevent similar action taking place in the future.

Outlet Works.

These works would consist of a straining tower about 50 feet high, covered at the top and provided with copper gauze screens: the water entering the tower at a depth of 7 or 8 feet below the minimum water level of the lake and after passing through the screens leaving by means of a culvert through the natural barrier already referred to, to the commencement of the pipe. It is proposed to instal a small water-driven turbine so as to work a pump for supplying high pressure water for washing the screens. The power for this turbine would be supplied by allowing water to pass from the lake to the valley below, the turbine being situated at the foot of the fall which has already been referred to. The screens would be made so that they can be lifted in rotation for cleaning purposes without interfering with the flow of water and the dirty water, after cleaning, would be discharged into the valley below the straining tower.

PIPE LINE.

Description of Pipe.

The ultimate top water level of the lakes has already been given, namely, 570 feet above datum.

The top water level of the service reservoir which will presently be described, would be 445 feet above datum. The distance between the outlet and the service reservoir is about 235,000 feet, and allowing for losses of head at the reservoir the hydraulic gradient would be approximately 1 in 1960, and with this gradient a welded or lockbar steel pipe, 54 inches in diameter, would deliver 25,000,000 gallons a day allowing for future encrustation. If rivetted steel pipes were used the internal friction is slightly greater on account of the rivet heads and the diameter of the pipe would be slightly larger to discharge the same quantity of water. The estimate has been based on approximate quotations received for 54 inch welded steel pipe, 7-16ths of an inch in thickness. With soft water considerable encrustation may be anticipated, but seeing that the Thirty-one Mile Lake water contains about four and a half grains of lime per gallon, it is probable that this may not take place to any appreciable extent. The Ottawa River water contains about two and a half grains per gallon and appears to have had very little effect on steel pipes which were laid many years ago without any protection by means of coating. It has been found that steel pipes are also liable to corrode from the outside if laid in saline or marshy ground unless special precautions are taken. The best protection in such cases is to surround the pipe with tarred hessian or jute, and provision has been made in the estimate for this precaution where the pipes would be located in swampy ground. To prevent freezing in winter, the pipes should be laid so that the bottom would come a minimum of 8 or 9 feet below the surface of the ground, and the estimate has been got out on this assumption.

Route of the Pipe.

This is shown on the plan. After leaving Long Lake the pipe would pass southward through gently undulating cultivated land for a distance of about one mile, until a cedar swamp is reached which would have to be traversed for a distance of another mile, when open cultivated land is again reached about two miles north of Ryanville. The ground is of much the same character between Ryanville and the Gatineau, which would be crossed at a point about 11 miles south of Long Lake by means of a bridge having a span of 150 feet. The estimate has been got out on the assumption that provision is made for two pipes across the bridge, each to be able to carry 25,000,000 gallons per diem, and the pipes would be housed in and surrounded with sawdust or some other suitable insulating material to prevent freezing in winter where they are brought over the bridge. After crossing the Gatineau, the pipe would proceed in a south-westerly direction, joining the C.P.R. about half a mile south of Low Station, passing through cultivated land and another cedar swamp between the river and this point, the total length of the pipe from Long Lake to the C.P.R. being about 16 miles. The distorted section gives rather a false impression of the country, which is in reality gently undulating and an easy route for a pipe track such as this. The haulage has been assumed for the portion of the track from depots at Kazabazua and Low Stations: the pipes to be brought to the side of the trench on sleds during winter; the distance from Kazabazua to Long Lake

being about 14 miles by road. From Low as far as Chelsea, a distance of about 24 miles, the pipe track would be in close proximity to the C.P.R., and this portion of the route would not be so easy from the point of view of pipe laying, a good number of minor works, such as bridges, stream-crossing and culverts being required. At Chelsea, the pipe would leave the C.P.R. and proceed nearly due south, passing close to Old Chelsea to the service reservoir, a distance of about four and a half miles. The service reservoir is located in the hills about two and a half miles south of Old Chelsea, and four miles northwest of Hull. The portion of the track between the C.P.R. and the service reservoir would be through cultivated land.

Service Reservoir.

The function of this reservoir is two-fold:—

1. To provide against a water famine in the town should the water have to be cut off in the aqueduct to allow of repairs being executed.
2. To meet the daily fluctuations in demand, as the water supplied to a town varies throughout the day, the maximum draught or peak load being nearly twice the average. A reserve must also be available in case of fire.

Supposing no service reservoir were provided, it would be necessary to lay two pipes all the way from the source of supply in order to be able to shut off one line, while the supply was kept up by the other. It is far more economical to lay out a gravity scheme of this nature so as to include a service reservoir of ample size than to lay a duplicate main when the aqueduct is long and a good site can be found for the reservoir at a suitable level. Fortunately, a good site at a suitable level has been found where the water would be stored in a basin having a flat bottom and surrounded by hills. The whole of the bottom of the valley has been cleared and cultivated, and there is one farm which would have to be purchased. The estimate includes for the stripping of the whole of this area to remove vegetable impurities which might tend to deteriorate the water. With the exception of this farm, the area which drains naturally to the basin is devoid of human habitation, and the hills are steep, rocky and covered with trees. A stream now passes through this basin and supplies water to farms lower down. This stream should be diverted round the reservoir as it would otherwise be held up in the reservoir, and the farms below would be deprived of some of their water. The bottom of the reservoir varies from about 410 to 416 feet above datum, and by means of three small dams the water would be held up to a level of 545 feet above datum. The water area would be about 54 acres, and one foot in depth, would represent approximately 15,000,000 gallons. The probable variation in water level to meet the daily fluctuation in demand would, therefore, be less than one foot. The contents of the reservoir between the level of 420 and 445 feet above datum would amount to about 295,000,000 gallons, and represents a reserve of about 12 days supply which is very ample when compared with what is allowed by other cities. The average number of days supplied in the service reservoir of the large towns in England, is from three to four days reserve. The static pressure given by this reservoir would represent 118 pounds at the pumping station, or 81 pounds at Parliament Hill, and is about the maximum pressure that the house fittings would stand in the lower parts of the city.

Pipes From the Service Reservoir to the City.

These pipes should be designed so as to be able to discharge for short periods during the day a much larger quantity than the pipes from the source to the service reservoir for the reasons which have already been given. The maximum rate of consumption is taken at 110 gallons per head per diem, and if unavoidable waste is added to this, say 40 gallons per head per diem, the total maximum rate of consumption would amount to 150 gallons per capita per diem. To this should be added the amount required for, say 25 fire streams, which would be equivalent to a rate of discharge of another 36 gallons per head per diem, so that the pipes should be designed so as to be capable of discharging 186 gallons per capita per diem as a peak load. On the basis of a population of 250,000 persons, the above rate would represent a discharge of 46½ million gallons per diem. Two 51 inch pipes would deal with this peak load so that when the population increased to 250,000 persons the pressure would not fall below 110 pounds at the existing pumping station, even should a serious fire occur during the period when the maximum demand was being made for water for domestic purposes.

Route of the Pipe.

After leaving the service reservoir, the pipes would be laid through cultivated land to the west side of Hull Station, so as to cross under the proposed Georgian Bay Canal, below the level of the bottom of that channel. If the canal is constructed, culverts should

be provided by the Canal Company at some future date to surround the pipe under the bed of the canal and allow them to be always visible for inspection. The pipes would then cross Brewery Creek about the site of the existing bridge at the end of Wright Street, and would pass through Hull till the bank of the Ottawa River is reached at a point about 1,400 feet east of the Union Bridge.

Crossing of the Ottawa River.

I have directed considerable attention to the question of this river-crossing and various routes have been investigated. The one finally selected for the purpose of the estimate being that shown on the plan. I am emphatically of the opinion that the pipes should be carried over the various channels at this point on bridges, as if the pipes are carried over a bridge it is an easy matter to inspect and maintain them in good condition, but once they are laid in the river bottom it is a very different matter. Another method which is equally effective is to construct a tunnel under the river and to lay the pipes through this tunnel. I am adopting this latter method in the crossing of the River Dee on the aqueduct from Wales to Birkenhead and have considered the possibility of crossing under the Ottawa in the same manner. The rock, however, is full of joints and I should anticipate considerable difficulty owing to the amount of water which would be met with in driving the tunnel under the river, so I have come to the conclusion that it would be better to pass over and not under the river. There are four channels which would necessitate first,—a bridge about 300 feet long on the Hull side of the River; then a bridge 500 feet long over the main channel of the river, then two short spans, one of 80 and one of 120 feet, the latter crossing the tail race canal from the present pumping station. For the longest spans, 500 feet and 300 feet in length, it is proposed to carry the pipes on suspension bridges which can be made light, and elegant in design, at a smaller cost than any other form of a bridge for these spans. Changes of temperature cause the decking of such bridges to rise and fall considerably at the centre of the span and allowance for this will, of course, have to be made by the employment of a special form of joint to prevent racking of the pipes. In order to prevent the freezing of the water in the pipes where they would be exposed to the air, I have considered the alternative of insulating them with a sufficient thickness of material and of carrying them within a light timber structure or shed, special provision being made to warm the air inside the shed in winter. The latter alternative permits of a lighter and cheaper bridge for the long spans, and I have, therefore, based the estimate on this assumption. Where the pipes cross the two narrow channels, the box girder form of bridge would be suitable, the pipes being laid in the interior of the box girder, and for such short spans I do not anticipate that any special provision will be required for heating. A section is shown which would give an idea of the appearance of the longest of the suspension bridge crossings, namely, that over the main channel of the river, and the estimate is based on the assumption that handsome masonry piers will be used to support the suspension chains at each bank. It would not surprise me to learn that at no distant date it was considered advisable to reconstruct some of the structures in connection with the Union Bridge, and the question of a new bridge joining Hull and Ottawa would come up for consideration. If this becomes a question of practical politics in the immediate future, it might be advisable to consider the road bridge and aqueduct as one problem, as the actual cost to increase the strength of the bridges so as to carry a roadway as well as the pipes would not be large. This would probably lead both to alterations in the position selected for the river crossing of the aqueduct and the level of the decking of the bridges. For the present, I confine myself, therefore, to an aqueduct crossing only, the bridges being designed so as to interfere as little as possible with the existing surface of the ground and of sufficient strength to carry four 51 inch diameter pipes which would give a maximum discharge at the rate of 93,000,000 gallons per diem without material loss of head between the service reservoir and the city.

Time of Completion of Works.

The various works which would have to be constructed to bring the water from Thirty-one Mile Lake and Pemachangan Lake to the city having now been dealt with, it will be necessary to consider the time it would take for their construction. In order to reduce this to a minimum, contracts for the steel pipes should be let as soon as possible so as to permit of delivery being commenced in the spring of next year. Before detailed contract drawings are prepared, further sections and plans will be required and trial pits and borings would also have to be made. If these were pushed on with at once, a sufficient staff being employed, the information could be obtained before winter sets in. This would allow of the necessary drawings, quantity and specifications

being prepared during the winter so that contracts could be let for pipe laying, etc., and work started in the spring of 1914. I am of the opinion that it would take three working seasons to lay the pipe and complete the necessary auxiliary works so that water could be brought in by 1917. Any delay now would mean that water could not be brought in from this source before 1918.

Annual Working Expenses.

These would be small and would not amount to more than $15,000 per annum to cover the cost of looking after and cleaning the screens at Long Lake, providing a keeper at the service reservoir, various watchmen along the line and a gang which could be employed at any point.

Summary Estimate.

Having now considered the main features of the project, it remains to give the estimate of the cost of the necessary works, which is as follows:

Head Works.	
Dam at outlet of Mitchell's Lake, to raise water surface to 570 feet..	$130,180
Clearing and burning area to be submerged	128,000
Tunnel between Pemachangan and Long Lake, including shafts, etc., 3,000 lin. ft.	119,630
Outlet works at Long Lake—straining tower, etc.	43,660
Smaller works about lakes, including subsidiary dams at depressions in height of land, temporary works at Pemachangan, lowering and clearing Long Lake, etc	72,000
Aqueduct to Service Reservoir.	
54″ steel main, 7-16″ thick, between outlet tower and service reservoir, 235,000 lin. ft.	4,314,080
Bridge on Gatineau River	30,000
Various smaller stream crossings and culverts	110,000
Service Reservoir.	
Dams	212,150
Clearing and stripping site	21,460
Inlet and outlet works	26,600
Aqueduct Service Reservoir to City.	
51″ steel main, 7-16″ thick between service reservoir and city, two lines of pipe each 32,000 lin. ft.	1,101,120
Various smaller stream crossings, culverts, etc.	20,000
Bridge across the Ottawa River	180,000
Total for works	$6,508,880
Add 15% for engineering and contingencies	976,320
	$7,485,200
Land, Lakes, compensation and Wayleaves as per Mr. Gendron's estimate	500,000
Total estimate	$7,985,200

ALEX. R. BINNIE.

Port Hope, October 31st.

A visit was made upon the request of Dr. Dickinson, Medical Officer of Health, to Port Hope in order to investigate conditions at present existing in the town. It appears that there is no municipal sewerage system of any consequence existing. A considerable number of private drains have become, by courtesy and by acquired right, common sewers. These empty at many points into the river which flows through the town. The pollution existing in the harbor is now considerable, and should be remedied at an early date. Dr. Dickinson was advised that it would be in the interests of the town for the corporation to engage a competent engineer to investigate the carrying capacity of the existing sewers and to draw up a scheme of drainage and sewerage for the municipality. Port Hope is a most sanitary municipality, which makes it somewhat difficult to present the sanitary aspect of its needs in reference to sewerage and sewage disposal. Financially, they are quite capable of undertaking a proper sewerage system.

Inquiry was later made into the water supply and an effort was made to account for the existence of such frequent pollution as is found in the water furnished from the filtration gallery. Tests were made of the sub-soil surrounding the galleries to determine whether any pollution could be detected. An examination of the samples showed that the sub-soil was practically free from the type of pollution in the galleries themselves, and that the pollution present in the galleries arises either from external agencies, such as mischievous persons placing excremental matter therein (which seems highly improbable, since the pollution is greatest in the locked reservoir), or by some communication between the gravel or rock strata and the harbor water or privies in the neighborhood draining towards the galleries. The water supply at the present time is being chlorinated by the use of fifteen pounds (15 lbs.) of hypochlorite per million gallons of water pumped. The water supply of the town can be rendered practically sterile by due observance and care in the administration of the bleaching powder.

Amherstburg, November 9th.

A visit was made to Amherstburg for the purposes of supervising the installation of two small chlorine pumps. Through the work of the International Joint Commission, the condition of the raw water at the Amherstburg intake was shown to be very seriously polluted, the pollution arising from the sewage of the City of Detroit and three municipalities on the Canadian side—Windsor, Walkerville and Sandwich. In order to decrease in a measure the inconvenience arising out of the use of bleaching powder as a disinfectant, it was thought advisable to instal small pumps for regulating the dosage of the disinfecting solution. These pumps were manufactured by the John Inglis Co., and deliver the solution to the pump-well, which provides storage and thorough mixing in consequence of its capacity and the action of the pumps.

In delivering a disinfecting solution to piston pumps it is almost impossible to regulate the flow so that the quantity of disinfectant is uniformly administered to the water, because every thrust of the pump sends through a quantity of water in excess of the average for the complete stroke. Where a suction well is in use, this difficulty is entirely overcome by feeding the solution to the well and regulating the quantity either by means of small pumps controlled from the piston of the main pumps or by means of Venturi control. Considerable

experimental work was done to determine the effect of hypochlorite on this water and efficient chlorination was found to be possible with the use of .6 parts available chlorine per million parts of water.

Woodstock, December 3rd.

An inquiry was made into the present condition of the Woodstock sewage disposal works. Investigation showed that the beds were not being operated correctly and that the effluent reaching the Thames River above Chatham was in very little better condition than the raw sewage being fed to the disposal area. At the present time the sewage appears to be distributed in channels several feet below the bed and filters laterally to the outlet. It is probable that the most economical system to instal at this date is that of a biologic filter fed with some apparatus such as a spray or other mechanical device promoting the even distribution of sewage. The effluent should be chlorinated.

REPORT OF WORK DONE IN THE LABORATORY OF THE PROVINCIAL BOARD OF HEALTH, 1913

To the Chairman and Members of the Provincial Board of Health of Ontario:

Gentlemen, I have the honor to present you the following report of the routine work done in the Laboratory of the Board at Toronto.

During the year 7,637 specimens were examined; during the same period 3,192 doses of Anti-typhoid vaccine were prepared and distributed throughout the Province in individual ampoules.

In the following table will be found a synopsis of the activities of the Laboratory.

Diphtheritic Swabs				1,314
Release from Isolation			320	
Positive		68		
Negative		252		
Diagnosis			994	
Positive		177		
Negative		817		
Tuberculosis Sputa				1,845
Positive		366		
Negative		1,479		
Bloods suspected of Typhoid				889
Positive Widal		202		
Negative Widal		687		
Cases given the Pasteur Preventive vaccination where there had been exposure to Rabies				49
Number of injections given		1,060		
Number of animal brains examined for evidence of Rabies				59
Negri bodies present		22		
Absent		37		
Milk analyses done for Local Boards of Health				295
Fat		155		
Total solids		2		
Preservatives		115		
Present	16			
Absent	115			
Tubercle bacilli		2		
Present	0			
Absent	2			
Bacteriological count		5		
Water analyses made				1,768
Bacteriological		1,743		
Chemical		25		
Liquors for the License Department				298
Miscellaneous specimens				60
Total specimens examined				7,637
Outfits sent out				8,045
Water		1,865		
Diphtheria		2,225		
Tuberculosis		2,091		
Typhoid		1,864		
Doses of anti-typhoid vaccine sent out				3,192

The great bulk of the specimens now received come in our own outfits. The data cards are being more satisfactorily filled out than formerly. Undoubtedly very many more outfits are being sent out than are returned, but there does not seem to be any way of avoiding this. The specimens are now sent in with much less danger to the public, the results are more satisfactory in the direction of examination and less excuses have to be made for results. The number of negative

results obtained is still in excess of the positives obtained. After allowance is made for alterations in transit, this proportion is probably accounted for by the fact that investigations are being more and more frequently asked for in doubtful cases.

Anti-Typhoid Vaccine:

Over 3,000 doses of anti-typhoid vaccine were sent out during the year. The bulk of these were sent to the Algoma, Nipissing, Rainy River and Thunder Bay Districts, to be used in the lumber, mining and construction camps. All reports received go to show that results of a gratifying nature have been obtained. No ill effects have been reported; the reactions have often been marked but only temporary. Leishman has found his best results when there have been good reactions. The reactions are more or less explosive, but last a much shorter time than do the reactions in vaccination against smallpox. This preventive measure is no longer in the experimental stage; the most gratifying results have been universally obtained. The immunity is even more complete than that obtained from vaccinia, both as to case incidence and mortality.

Several practitioners in outlying districts have been using it in private families where typhoid has broken out, hoping to prevent development in the rest of the inmates of the house, especially where the patients have to be nursed at home. This seems to be good practice and worthy of encouragement. So far very few of those to whom we have sent vaccine have used it in treatment; there is a field here also.

The following circulars are now enclosed with all quantities of vaccine sent out. They are self-explanatory.

The Public Health Act (Secs. 53 and 55) requires notification within 12 hours by physician and householder of this disease under penalty of not less than $25.00.

THE VALUE OF ANTI-TYPHOID VACCINATION AND THE TECHNIQUE OF INOCULATION, FOR THE PREVENTION OF TYPHOID OR ENTERIC FEVER.

Brief Historical Sketch.

Like most medical discoveries, the final perfection of the practice of Anti-Typhoid vaccination has resulted only after years of experimentation, and apparent failure. To Sir A. E. Wright, of the British Army Medical School, must be given the honor of having first conceived the idea of this Anti-Typhoid vaccination.

The outbreak of the Boer War afforded an ample opportunity for the practical application of this prophylactic measure. The results during this campaign, although not as great as had been anticipated, yet were of sufficient significance to arouse international interest. The German army next took up the investigation, and as a result during a campaign in South-West Africa the Typhoid Fever rate was reduced one-half by vaccination. Striking results were shortly obtained in India, where careful observations were made on 6,000 vaccinated and 6,000 non-vaccinated soldiers living under similar conditions. Seven times as many of the non-vaccinated contracted typhoid, and eleven times as many died of it. The Medical Service of the United States army, although entering quite recently into this field of specific prophylaxis to combat Typhoid Fever, furnish us with abundant evidence as to its value. The procedure was introduced into the army in 1909, shortly before the mobilization of the troops on the Mexican border. As a

result only one case of Typhoid Fever developed amongst the 18,000 men during their encampment.

These facts seem almost incredible when we consider that within three and a half months of the date of mobilization for the Spanish American War, 20,783 cases of Typhoid Fever with 1,580 deaths occurred.

The trial has now been made long enough and with such uniformly good results that it is time that this procedure should be seriously considered in civil life.

The Value in Civil Life.

The old adage of "Prevention is better than Cure" will continue to be the foreword of the modern medical practitioner, and yet with all our attempts, successful as they are for clean, wholesome milk, pure food, pure water, healthful surroundings and the control of contacts, we are still face to face with the problem of the so-called sporadic cases of Typhoid Fever. No one doubts the value, yea the necessity of these factors in the prophylaxis of Typhoid Fever, and it is gratifying to see that the country as a whole is rapidly realizing that this dread scourge is truly preventable. But these safeguards, unfortunately, are not afforded to all the citizens of our Province. These cannot obtain as yet in the rapidly developing Northern country with its new towns and hundreds of mining, construction and lumber camps. To the members of such communities Anti-Typhoid vaccination offers an almost absolute personal immunity as an adjunct to the best sanitary measures which can be taken by the community as a whole under these more or less difficult circumstances.

The value of Anti-Typhoid vaccination has been at once appreciated in countries where the opportunity of immunization has been offered to those who in their daily life are dealing directly or indirectly with Typhoid Fever cases.

Nurses attending Typhoid cases obviously undergo unusual exposure to infection, the Typhoid morbidity amongst them being about ten times that of average citizens. It has been demonstrated that the case incidence amongst uninoculated nurses was nine times as great as amongst the inoculated. Physicians, medical students, and all those coming in contact with known or doubtful cases are in greater numbers availing themselves of this "Typhoid vaccination method."

A prophylactic dose of diphtheria antitoxin is now the recognized measure of safeguarding the exposed members of a family. Does it not seem reasonable, yea necessary, to similarly safeguard those exposed to Typhoid when so useful a prophylactic is available?

Typhoid vaccination is not limited in its sphere of usefulness to the conditions previously mentioned. Undoubtedly its application will become more and more general when we realize how useful and potent a prophylactic measure is at our disposal. One who has followed carefully the results of many thousand inoculations covering a period of several years recently stated that he believed it to give greater protection against Typhoid than does vaccinia against variola.

Nature of Vaccine. The vaccine is prepared by growing a known strain of Bacillus Typhosus in bouillon usually for 48 hours, when a heavy culture is obtained. This is sterilized by heat, using as low a temperature as possible. The bacterial content is then estimated and numerically standardized so that 1c.c. contains 1,000 million. Carbolic Acid in the proportion of .5 per cent. is added as a preservative. The whole process requires great care if extraneous contamination is to be avoided. Purity tests and animal inoculations are made on each brew before leaving the laboratory.

Forms in which Vaccine is Distributed. In order to minimize waste the vaccine is sent out in 1c.c. phials when single or few doses are required, and in bottles with rubber caps containing 25 or 50c.c. when a number of individuals are to be inoculated.

INSTRUCTIONS FOR USING ANTI-TYPHOID VACCINE.

Method of Drawing Vaccine into Syringe. First the syringe must be boiled to insure sterility. *When using from ampoule* make a light file mark at base of neck, then break with fingers. The ampoule can be inverted over the needle without any danger of the vaccine escaping. The needle must always be kept below the level of the fluid while this is being withdrawn, thus avoiding the entrance of air into syringe and allowing every drop to be removed from the capsule. *To remove vaccine from bottle,* first shake well, then wipe rubber cap thoroughly with iodine or carbolic acid, pierce the rubber with needle, invert the bottle and withdraw required amount.

(The syringe must be allowed to cool before filling with vaccine.)

Instructions as to Making Inoculations. The most suitable place to make the injection is on the outside of the arm into the subcutaneous tissue. The injection must not be made deeply into the muscles. The arm should first be thoroughly cleansed with soap and water and then some antiseptic applied. Tr. Iodine diluted 1/2 with Alcohol is very suitable for this purpose. When many individuals are to be immunized at one time the previous preparations can be done by an assistant.

The syringe need not be sterilized between injections; the needle must be. It is advisable to have several needles and drop them as used into boiling water, thus preventing loss of time in sterilizing. The needles should always be of small calibre and sharp, then little objection will be raised to the injection. Also the rubber caps on the bottles will not be perceptibly injured. When the latter have been seriously damaged by the use of large needles, the remaining contents should be discarded, due to possibility of infection.

Dosage. Experience has shown that immunization is best obtained by giving two injections. The first of 500 million dead bacilli, followed in ten days by a second injection of 1,000 million dead bacilli.

The inoculated should clearly understand that the maximum degree of protection cannot be obtained unless *both* injections are carried out.

The following doses should be employed when immunizing others than adults:

For children from 7 to 12 years	1/4 dose.
For children from 12 to 15 years	1/2 dose.
For children from 15 to 18 years	2/3 dose.

Children under 7 years of age should not be immunized unless small doses are given with great care.

It is most important to thoroughly shake the vaccine before using, as the dead bacteria settle out, leaving a clear fluid above.

No person should be immunized who is not healthy and free from fever at the time. A suitable time to administer is about four p.m., as then a greater part of the reaction will be over by the morning.

Clinical Symptoms which may be Expected to Result from the Anti-Typhoid Inoculation. Some degree of malaise may be expected in every case. A slight rise of temperature generally occurs: this, however, passes off within twenty-four hours. Faintness sometimes occurs. This should be guarded against by keeping the inoculated at rest. In no case should violent exercise be allowed for twenty-four hours.

In every case a certain amount of local swelling and redness will occur—the local reaction. This extends over an area as large as the palm of the hand. This is quite transient, passing away within twenty-four to forty-eight hours. No local treatment is necessary. Alcohol should never be allowed within this period, otherwise the reaction may be quite severe.

The vaccines must be stored in a cool, dark place, and not used after date stamped on box containing them.

To eliminate error as much as possible, all ampoules and bottles containing vaccine for first inoculations have instructions printed in *black type*. The directions for second inoculations are always printed in *red type*.

PREVENTION OF TYPHOID FEVER.*

How many now entering upon active service realize that Typhoid Fever will be their greatest enemy? In the South African and Spanish American Wars, the mortality from this disease was greater than from the bullets of the enemy. Look at these figures:

South African War.

Number of men engaged	380,000
Number of cases of Typhoid	57,000
Number of deaths from Typhoid	8,200
Number killed in action, or died from wounds	7,772

Spanish-American War.

Number of men engaged	120,000
Number of cases of Typhoid	20,730
Number of deaths from Typhoid	1,580

Can Typhoid be Prevented?

To this extremely important question our emphatic answer is YES. When all precautions are taken a few cases will still occur, but the great majority can be avoided by the use of Anti-Typhoid Vaccine. The following figures will convince you of its value.

Experiments conducted in the British Army, India.

Number of cases per 1,000 men not vaccinated	28.3
Number of cases per 1,000 men vaccinated	3.8

Over 12,000 men volunteered for this experiment and all were under similar conditions.

Experiments conducted in the United States Army.

Number of cases amongst 10,759 troops mobilized at Jacksonville, 1898	2,693
Number of cases amongst 12,000 troops mobilized at St. Antonio, 1912	1

These camps were under very similar conditions except that the men in 1912 were protected against Typhoid by Anti-Typhoid Vaccine.

Is there any Danger in Being Immunized?

With no adverse reports after its use in this country on many hundreds of people, in fact the whole Regular Army of the United States have been thus protected, we can with confidence say that no injury will result from vaccination.

Directions to Those Being Immunized.

1. Use no Alcohol for the preceding twenty-four or subsequent forty-eight hours.

* This circular was distributed extensively among the Canadian troops sent (1914) to the assistance of the Allies. All the anti-typhoid vaccine used was supplied gratuitously by the Provincial Board of Health.

2. Rest the inoculated arm as much as possible during the twenty-four hours following the injection.

3. Complete protection is only produced by having two injections 10 days apart so be sure and return on the tenth day for the remaining dose. Little inconvenience is experienced from the last injection.

4. Because thus protected do not run foolish risk, be careful, and avoid as far as possible all sources of infection.

Anti-Typhoid Vaccine supplied free of charge by the Provincial Board of Health of Ontario.

Rabies.

Rabies has been with us all year; fortunately it has not spread east of the County of York. Fifty-nine animal brains, chiefly dogs, have been examined for Negri bodies. These have been found in 22 of the 59 brains examined. Preventive treatment was given to 49 patients, most of whom had been injured by rabic animals. In some cases there was only a suspicion of infection—to be on the safe side the treatment was taken. We have had no ill results. We are now using vaccine prepared by the Laboratory of the Department of Hygiene of the University of Toronto and are well satisfied with the results. We have not the anxieties on account of delay caused by interruptions of the mails which we have had in the years gone by. We owe a great debt of gratitude to the Department of Health of the City of New York for their kindness, courtesy and help given us in supplying vaccine from the beginning of our outbreak until the month of September last. They were even kind enough on one occasion to send one of their laboratory staff to help us out in initiating the treatment; their action has throughout been an illustration of the altruism of true Public Health Workers.

Water.

There were examined 1,768 samples of water. A remarkably large number showed the presence of colon bacilli, especially the well waters, demonstrating how defective the tops and curbs of wells are. Such infection nearly always takes place through the top. It rarely happens that infection takes place through the soil.

We have sent out large numbers of the following circular in reference to purification of water for small parties. It has been found efficient and useful and it is popular.

A Simple Method of Water Purification.

A level teaspoonful of chloride of lime should be rubbed into a teacup of water. This solution should be diluted with three cupfuls of water, and a teaspoonful of the whole quantity should be added to each 2-gallon pail of drinking water. This will give .4 or .5 parts of free chlorine to a million parts of water and will in ten minutes destroy all typhoid and colon bacilli or other dysentery-producing organisms in the water. Moreover, all traces of the chlorine will rapidly disappear.

This method of purification has been tested with Toronto Bay water inoculated with millions of bacteria. Every germ has been destroyed and it has been unnecessary to boil the water.

This method should be very valuable for miners, prospectors, campers, and those living in summer resorts where the condition of the waters might not be above suspicion.

Milk.

Milk is analyzed as a routine for fat, total solids and preservatives. Only a few of the smaller municipalities have milk by-laws; the larger ones practi-

cally all have, and maintain their own laboratories. The smaller places generally accept what milk is presented to them without question. Bacteriological examinations are rarely made because the difficulties met with in transport are so great that, in case large counts are found, they could not in fairness be used as ground for prosecution against vendors; count cultures should be made from the wagon or, at least the sample taken should so be treated with ice that abnormal multiplication does not take place before the culture is sown. As to the search for tubercle bacilli—if they are found in milk by the ordinary methods, the milk should certainly be condemned; unfortunately very dangerous milk will not show them by ordinary bacteriological methods. Inoculation into animals should be made, but even then we must admit that all specimens of milk given by a tuberculous cow would not invariably show the organisms. The animal suspected of giving tuberculous milk should be tuberculin-tested, but this test does not show only open tuberculosis. The one safest plan since tuberculosis is so common (perhaps 10 per cent. of our cows are tuberculous), until more careful methods than are now in force can be introduced, should be to pasteurize by the "holding method." A few dead tubercle bacilli in a specimen of milk will do no harm; living ones may do a great deal.

Preservatives have been found in 16 of the 115 specimens submitted for such analysis and in each case has been some type of formol preparations, the most dangerous of all the preservatives used in milk.

Liquors.

The Laboratory is still making analyses of liquors for the License Department of the Province, 298 such analyses having been made during last year.

Research.

Studies relating to several problems have been undertaken and are still engaging attention, but nearing completion, viz.:—The longevity of the typhoid bacillus in water, the "virulence of the resistant minority" in diphtheria, the possibility of infection through the trachea and bronchi, problems in connection with food poisoning, and studies in connection with joint-ill in colts and contagious abortion in mares, the latter being carried out for the Department of Agriculture.

International Joint Commission.

The bulk of the medium for culture used during the investigation of the waters of the Great Lakes and their connecting rivers was made in this Laboratory—of bile medium alone nearly 2 tons were made.

Sanitary Investigations.

Several investigations were made by members of the Laboratory staff. Among these might be mentioned our share of the work in the field work for the International Joint Commission, and inspections of the Collingwood water supply, the water and sewage systems prepared for Picton, water supply for Dundas, Berlin Sewage Disposal Plant, and an investigation in connection with an ice supply problem in London, all of which reports are included in this volume.

All of which is respectfully submitted.

John A. Amyot,
Director of Laboratories.

Table showing in Synopsis the number and characters of the

Counties.	Diphtheritic swabs: Release +	Release −	Diagnosis +	Diagnosis −	Tuberculous sputa +	Tuberculous sputa −	Typhoid bloods +	Typhoid bloods −	Pasteur preventive treatment: Cases	Number of injections	Rabies diagnosis: Animal	Negri bodies +	Negri bodies −	Animal inoculations
Algoma	12	52	11	13	15	32	6	17						
Brant		1	1	3	4	43	4	11			dog		1	
Bruce		4	2	11	12	38	3	12						
Carleton				3	2	31	6	13						
Dufferin				6	2	14	2	9			dog		1	
Durham	16	41	11	34	7	64	10	16						
Elgin				3	1	13		3	2	47	dog	2		
Essex			4	23	16	49	4	16	2	48	"		2	
Frontenac							1	1						
Glengarry		3		4	4	5	2	7			dog		1	
Grenville		6	1	2	3	6		2						
Grey	4	8	6	28	7	59	7	40						
Halton	8	17	6	30	6	24	2	8						
Haldimand			2	6	11	15	2	3						
Haliburton		1		2		3								
Hastings	1	3	4	7	8	45	4	12	1	14	dog		1	
Huron			2	11	17	39	10	33			"	1	1	
Kent			1	11	21	79	5	18	2	50	"		2	
Lambton			6	15	9	33	2	8			"	1		
Lanark		1	1	7	6	20		7						
Leeds			2		3	2	2	2						
Lennox and Addington														
Lincoln	1	8	6	10	13	45	1	18						
Middlesex				3		15	2	2						
Muskoka	1	8	11	25	3	23	4	9						
Nipissing		5	10	18	13	58	9	28						
Norfolk		1	1	8	6	31	3	28			dog		1	
Northumberland		3		8	7	23	9	24			"		1	
Ontario	1	2	2	15	6	51	3	14						
Oxford	1	1	4	17	17	79	17	48			dog	1		
Parry Sound	2		5	24	8	42	5	17			"		1	
Peel		4	1	17	5	24	3	18						
Perth	1	2		16	7	31	7	24						
Peterborough		4	5	7	5	20	6	17			dog		2	
Prescott						4		3						
Prince Edward		1	2	13	3	10	1	2						
Rainy River			1	5	8	10					dog		1	
Renfrew				10	8	30		3						
Russell	1	28	3	14	3	12		1						
Simcoe	1	1	9	32	21	111	24	59			dog	2	1	
Stormont				5		8	1	2						
Thunder Bay					2	13	1	10	1	26	dog	2		
Victoria				5	11	29	1	7						
Waterloo	4	14	10	46	22	62	4	23			dog	1	2	
Welland			1	3	4	9	6	12	3	78	"	1	1	
Wellington	3	11	6	29	17	58	13	34			"		3	
Wentworth	3	1	4	6	3	8	1	1						
York	8	21	36	262	20	59	9	25	38	797	dog	11	15	
Total	68	252	177	817	366	1479	202	687	49	1060		22	37	

specimens dealt with in the Laboratory during the year 1913.

Milk: Food Content: Fats.	Milk: Food Content: Total Solids.	Milk: Preservatives: +	Milk: Preservatives: —	Milk: Bacteriological: Tubercle Bac.: +	Milk: Bacteriological: Tubercle Bac.: —	Milk: Bacteriological: Pus cells: +	Milk: Bacteriological: Pus cells: —	Milk: Bacteriological: Count.	Milk: Extraneous matter.	Waters: Chemical.	Waters: Bacterial.	Liquors for License Dept.	Doses of Typhoid Vaccin. sent out.	Miscellaneous specimens.	Total examinations for the year.	Outfits sent out: Water.	Outfits sent out: Diphtheria.	Outfits sent out: T.B.	Outfits sent out: Typhoid.	Outfits sent out: Total.
					1						13		320	2	494	36	90	80	54	260
4											5			1	78		6	55	6	67
											11			7	100	11	36	35	36	118
											8				63	17	18	25	18	78
											6		8	3	51	6	30	25	30	91
1											68		4	1	273	62	132	90	132	416
											2			6	79	8	11	11	6	36
											13			1	178	28	12	40	18	98
											2				4	22	48	45	60	175
											18		8		52					
											2				22	32	180	20	24	256
											11				170	24	60	60	54	198
2			2								21				126	44	78	35	24	181
										1	14				54	22	12	10	12	56
															6		18	15	18	51
											20		8		128	30	72	65	48	215
3			3								32		16		178	41	48	40	36	165
1			1								10				201	12	54	50	60	176
1			1								25			2	103	14	84	85	72	255
											15				57	42	66	25	36	169
											6				17		30	35	12	77
																		5		5
118	2	16	102							1	144		8	1	494	153	78	95	54	380
											58				80	58	18	30	18	124
											9				93	34	86	25	18	113
7			5		1			5		1	177		1220		1557	145	42	70	36	293
											8				87			5		5
											19				94	43	42	50	42	177
											23			1	118	27	66	75	66	234
											14			4	203	26	96	135	168	425
											85		24		213	67	54	55	42	218
7											85		32		196	78	60	50	66	254
											22			2	112	15	54	45	54	168
1			1								4				73		36	20	24	80
															7	10	6	5	6	27
											4				36	1	36	30	30	97
										3	19		288		335	21	24	20	24	89
											98		80	1	230	192	30	75	46	343
											2				64	15	60			75
9										7	164		16	1	458	181	72	105	60	418
															16		36	30	36	102
											8		1108		1,171	3		10		13
											27			1	81	12	12	30	12	66
										3	106		8	5	310	103	108	105	138	454
										2	125			1	246	91	42	35	42	210
										2	56		16	1	249	40	78	95	84	297
										3	45				75	54		5		59
1										2	139	298	28	19	1,788	45	54	40	42	181
155	2	16	115		2			5		25	1743	298	3192	60	10,830	1865	2225	2091	1864	8045

REPORT ON THE COLLINGWOOD WATER SITUATION.

Collingwood derives its wat r supply from the Georgian Bay at a point approximately one thousand f et from shore at the north-east corner of the municipality. The pipe is a twelve inch one and lies on a shelving limestone bottom. The intake is in approximately seventeen feet of water. Just near the pumping station on the land is a small basin about twenty by fifty feet and five or six feet deep, intended to hold enough water to supply the pumps in case of some special emergency, fearing the twelve inch pipe cannot deliver a sufficient quantity. This is in the open, uncovered and would probably be of very little use, and had best be cut off. There is a creek emptying into the Bay about one-third of a mile east of the pumping station. During flood time, and there is usually one after every heavy rain, enough water comes down by this creek loaded with silt, to work its way out beyond the intake and at the time of my visit a full mile out from shore. This creek runs through a district rather thickly inhabited and probably a good deal of sewage, both animal and human, reaches the stream at irregular intervals. The records of the Town in the Registrar-General's report show a good deal of Typhoid (62 per 100,000—average for last 3 years). Even if but half of this comes from the boat traffic, it is high. Undoubtedly this creek is a menace to the water supply of Collingwood. The bulk of the sewage of Collingwood itself is emptied into the harbor, but at times must reach the open bay, and with a strong wind from the west there would be nothing to prevent it reaching the intake. The town authorities are perfectly alive to the necessity of changing this condition, and in looking over the situation it would seem that the plan of their engineer is a perfectly feasible one and will give the Town a safe water supply. His proposition is to put in an extra intake to supplement the twelve inch one and thus give a fourteen inch and a twelve inch intake in place of the single twelve inch one now existing. The intakes will be nearly one-third of a mile apart and it is propsed to place the new intake in a trench to protect from ice action, the inner end to be made fast with concrete. This extra intake would seem to be a necessity. The town has outgrown the old one and it is a question if the old one could supply a sufficient quantity of water in case of a large fire. To meet the turbidity and the occasional possible pollution of the water, he proposes installing a gravity mechanical filter, deeming it the safer one because closer and more exact observation can be made of its working than putting in a pressure mechanical filter, and I am firmly convinced that he is right. It is also provided in his proposition that the water be disinfected after the filtration. He also proposes putting in some twenty-five hundred feet or more of water main in larger size than the one at present in use, to give the water to the town at a higher pressure. This would also seem to be a necessity on account of the rapid growth of the town and prospects for the near future.

Other propositions have been put forward for the correcting of the conditions in Collingwood but this present one seems to meet the requirements better than any of them.

These propositions are, first, to go to the mountain some four miles and a half to the west of the town and develop certain springs found near the top, and in this way get a gravity system for the town. No very special examination has been made of the quantity of water or its qualities, except to measure one spring. The spring would give sixty-eight thousand gallons a day according to data furnished by the town authorities. The town needs about seven hundred thousand gallons a day at the present time. Several springs would have to be developed. It is a question whether the catchment area would supply enough water even

along with this one to give a requisite amount. The water is hard. The proposition would require an expenditure of a large amount of money and it is a question whether the town could afford it even if the quantity could be got. Collingwood depends a great deal on manufacturing plants which would use a great deal of the water, and the hardness, if it is uniform for all the springs, would be an objection to this source.

Another proposition is to build a pumping station to the extreme west of the town and go out a mile or more into deep water and get the supply. They would approach very closely then to the line of boat traffic. The intake would not be absolutely free from danger from the harbor and besides there are several creeks pouring into the Georgian Bay in the neighbourhood and this would give a great deal of turbidity to the water, just as happens in the east end. The water would have to be treated by filtration and chlorinated just as in the case of the present proposition. The danger of infection would not be as great with the present intake, but would still exist. The advantage would hardly be compensation for the increased expenditure that would be necessary. The proposition above outlined would then seem to be decidedly the best under the circumstances for Collingwood.

FURTHER REPORT ON A POSSIBLE MOUNTAIN SPRING WATER SUPPLY FOR COLLINGWOOD.

On January 19th, 1913, an investigation into a proposed alteration and extension of the Collingwood water supply was made.

In considering the other sources of supply than the Georgian Bay one, mention was made of a possible mountain spring supply. The information supplied with reference to gauging was meagre, but from the best that could be got at that time the suppy seemed too small. It was not seriously considered. Also the scheme had previously been reported against (possibly inadequate supply and cost of installation). Since then the town has grown and other information has been obtained. For instance, it was found that the former figures supplied were from a 4-inch weir measurement taken off a weir that was 15 feet long and no account was given of the remaining 14 feet, 8 inches.

On April 12th and 13th, 1913, a new investigation was carried out on the ground with the view of finding as to whether the quantity was sufficient and as to whether the quality was of such a character that the source should be considered before finally deciding on the Georgian Bay supply, which had just recently been nearly settled on.

The mountain is a continuation of the escarpment beginning at Queenston going through back of Hamilton and Dundas. Behind its crest is a level plateau extending miles to the west. In the neighborhood of Collingwood the elevation of the highest point above the Georgian Bay is said to be approximately 1,000 feet. From the water level up the formation consists of black Utica shale, about six hundred feet of red Medina shale (red clay) overlaid by from fifty to one hundred feet of grey Niagara limestone in thick strata. There are a number of caves in this layer and of course many irregular fissures.

Eight springs in all were visited. All of them gush out at about the same level, though miles apart, from between the Medina shale and the Niagara limestone. Five of them gush forth in the extent of three-quarters of a mile. Of the other three, one arises to the north of this group, as the crow flies about one-and-a-

half miles. The other two each about a mile away to the south and east. There are other springs to the south, but they were not visited as they were farther away and those examined served the purpose of the investigation. The catchment area for all these springs is the level plateau behind. It is several miles in extent and is chiefly farm land and low lying swamps. There is a good deal of run-off by small streams, but much of the rainfall must of necessity sink down into the soil and work its way down through crevices to the lower layers of the limestone to the Medina shale and at low points gush forth. This Medina shale is impervious.

The water as it gushed forth in the various springs showed turbidity, probably not more than two parts per million in any of them, but enough to show that it comes through crevices. This might not happen in the dry seasons, but only in the wet weather, when much reaches the waterbed. This turbidity is of considerable significance. It means that if there was polluting material on the catchment area it might reach the springs. This is one of the faults of all limestone springs. One never knows when pollution will reach them. To avoid accidents such water must always be efficiently purified. Analysis shows these waters to contain one part of chlorine per million and, therefore, that it does not come a long distance from the source to the springs—more reason why it should be purified. Of total hardness they show 214 parts per million. This low hardness again indicates that the water does not run a long distance through the rock. This again is probable evidence pointing to the necessity of purification, right from the start. The purification of this water by slow sand filtration would probably meet all requirements provided the filtration was done right close to the springs.

This total hardness is not excessive (214). That of the Georgian Bay is 122, of Lake Ontario 132, of Berlin, Ont., 340, that of Stratford nearly 500, that of Preston Springs about 500 parts per million.

The advantage of this hardness is towards palatability and the prevention of solution in lead pipes.

The temporary hardness is 185, that of the Georgian Bay supply 85 parts per million. This means that the mountain supply would encrust boilers over twice as much as the bay water and would require more soap for washing also. This is a disadvantage but not a very serious one.

What has been said of five of these springs with reference to quality probably applies as well to the other three.

The north spring is known as the McLeod spring. It runs independently into the valley and if required could probably be easily led to a general supply without great cost.

The group of five springs is locally known as the Osler springs and from the chief source of Silver Creek. They now collect in low land near the springs to run over a small dam known as Osler's upper dam. The next spring south arises about three hundred yards south of the 9 and 10 road and empties into Silver Creek about one-half a mile below the lower Osler dam, which in its turn is about half a mile below the upper Osler dam. This is the largest of the springs making up the lower Silver Creek. The last spring giving rise to the Black-Ash Creek arises about half a mile to the south-east of the last spring spoken of. This Black-Ash Creek does not join Silver Creek, but at one point about a mile and a half below the upper Osler dam comes to within one hundred and fifty yards of Silver Creek with a low rising ridge between. At this point it could be easily diverted to the Silver Creek if later it should be needed to supplement the Osler mountain supply.

No examination was made as to the bacteriological quality of the various springs. At present they are open to surface drainage, and a great deal of this was

going on at the time of the investigation. Also any such examination to be of value would have had to be continued over an extended length of time and under varying conditions. The danger with such waters is from chance and very occasional infections. Long continued negative results would give a sense of security that would not be justified. The survey indicates quite sufficiently the possibilities of such infections. No one would be justified in recommending these waters to be used without a safeguarding purification.

As to *quantity*—no first hand gauging was done. There was not time. A day or two's estimate would not give the information required for the rest of the year, besides the excessive surface run-off that was going on at the time would have introduced too large an element of unknown quantity.

We were very fortunate, however, in that Mr. Charlebois, who has rights over the Osler springs and the stream developing from them, had taken very careful readings almost daily over a period of three years (1909-10, 1910-11 and 1911-12) and that he generously supplied us with a carefully made table of these readings. He demonstrated his method of taking the readings. It is the accepted method amongst engineers for such work, and gives evidence of very careful, honest work. He had not taken the measurements with the idea of a town water supply, but in connection with the development of an electric power scheme in which he was much interested. He has other valuable information which he has expressed his entire willingness to supply the town authorities in connection with these springs. From my own experience of streams I am confident his measurements are the best evidence possible. Also from information obtained from residents of the neighborhood as to the constancy of the flow I am satisfied his results are correct. Also, we have confirmation in the former statement made as to the quantity measurement made a year or so ago, that over a 4 inch weir 68,000 gallons a day was the flow, which figured out for the 15 foot weir gives 3,060,000 gallons per day.

According to Mr. Charlebois' data, the average daily flow over three years was 3,661,000 gallons. This would be a supply for 30,000 people. The minimum flow over the three year period was 1,800,000 gallons. This alone would be ample for 18,000 people. With retaining works that would not be prohibitive in cost, the maximum flows could be held over for the minimum periods. The average then would look after 25,000 people easily.

There seems to be no justifiable doubt as to the requisite amount being obtainable for at least 25,000 people from the Osler springs.

The other three springs if they held, and there is no apparent reason why they should not, would probably supply another 3,000,000 gallons per day. By the time they would be required there should be no hesitation about going into the extra expense of connecting them up with the Osler system.

Without making any allowance for slip, the pumping record of the Collingwood water system shows an average daily pumpage of 816,000 gallons.

Appended will be found an analysis showing the comparative hardness and the chlorine content of both waters, also Mr. Charlebois' table of weir measurements and the record of pumping for 1912 from the Water Department of the town.

From the above data gathered it would seem that the mountain supply at this juncture should be given consideration. Especially in view of the fact that there is a widespread feeling through the town that this supply is the preferable one.

There is enough water for a municipality much larger than Collingwood now is. The quality is good, from the sanitary point of view better than the Georgian Bay supply. By the careful management of well known methods of purification the Georgian Bay supply could be made satisfactory.

The choice betwen these two sources is principally a matter of cost.

According to Mr. Chipman's estimate the present supply could be made satisfactory for $75,000 and added to as the town grows.

The mountain scheme would probably cost much more. Any reasonably accurate figure could be got only by having a competent engineer go over the ground and see what difficulties would have to be met.

The Osler springs alone would probably supply 18,000 people without any difficulty, with almost no additional development.

The gathering basin would require to be cleaned of all fallen wood and debris. The dam would require very little rearrangement to meet the present needs. If the water is filtered in the neighborhood of the present upper Osler dam the slow sand method of filtration would do all the purification that is needed at the smallest cost in maintenance for the same security. The water here will show the minimum of turbidity and pollution, and the filtration could be done entirely by gravity.

Filtering at this point would require that the piping to the town begin right at the filters, so that there would be removed all chance of any pollution thence to the town taps. A break in the head would have to be provided on the way down, for the fall would be close on to 800 feet.

It has been suggested that the pipe line should begin at the foot of mountain at about the 250 foot level. This would eliminate the cost of nearly two miles of pipe and thus reduce the cost. But this would allow to enter the additional risk of infection over the two miles, which might be serious. Also, the water running in the open and down the clay bottom would gather much turbidity. This would practically preclude slow sand filtration. Mechanical filtration would have to be adopted. This would add to the cost of filtration. The additional possible infection might require chlorination of the water after passage through the mechanical filters. Then a low lift pump would probably have to be put in for washing the filters. More skilled labor in the management of the filters would be required than if slow sand filters were used. The cost of chemicals and the labor would offset the cost of installing the smaller mechanical filters.

Commencing at the upper Osler dam would seem to me the better plan. The extra cost of the pipe-line would probably be neutralized by the additional cost of the special filtration in the second plan.

The piping from the 250 foot level to the town would be the same in both.

The whole proposition would seem then to be a question chiefly of cost.

COMPARISON.

Mountain Supply.	Georgian Bay.
Quantity:	*Quantity*:
Enough probably for 35,000 people from the 8 springs.	Inexhaustible.
Quality:	*Quality*:
Subject to slight infection.	Subject to much.
Harder, but not high.	Softer, less incrustation, less soap.
Turbidity at Osler Dam slight at any time.	Subject to being very turbid.
Must be purified.	Must be done much more carefully and at greater cost.
Seven and a half miles away.	At hand.
Would come down by gravity, avoid all cost of pumping.	Must continuously be pumped.

In this last respect comparative costs must finally settle the question.

Would advise that no delay in getting engineer's estimate as to comparative cost be made. Collingwood is in emergent need of a pure water supply.

Weir measurements of Silver Creek near Collingwood, Ont. Table 1 gives the monthly flow in cubic feet. Table 2 gives the least daily flow in cubic feet.

Copy of Mr. Charlebois' table:—

(1)	1909-1910.	1910-1911.	1911-1912.	Average.
May	33,051,532	28,687,760	33,575,440	31,771,577
June	19,453,776	19,484,064	17.752,258	18,896,666
July	14,099,070	15,721,426	13,536,672	14,452,389
August	8,031,460	13,417,676	12,780,712	11,409,949
September	8,124,208	11,418,276	10,422,944	9,988,476
October	11,921,040	12.683.064	12,286,632	12,296,912
November	14,671,336	12,195,416	12,380,208	13,082,320
December	18,014,400	11,623,384	10,534,176	13,390,641
January	14,622,768	14,718,672	11,917,712	13,753,050
February	11,446,848	13,397,370	12,389,504	12,377,907
March	22,476,178	20.042.408	17,538,112	20,018,899
April	35,770,860	43,552,364	47,862,698	42,395,307
	211,683,476	216,841,880	212,977,068	213.834.141

The least daily flow in cubic feet.

(2)	1909-1910	1910-1911	1911-1912	Remarks
May	887,000	751,000	829,000	
June	521,000	536,000	505,000	
July	333,000	456,000	409,000	
August	238,000	393,000	373,000	Up to Sept. 18th, 1909, dam had
September	191,000	364,000	334,000	leaked badly. after dam was
October	333,000	318,000	334,000	made tight (Sept. 22) and water
November	349,000	373,000	373,000	made to pass over the Weir,
December	505,000	364,000	349,000	the flow measured on that day
January	440,000	440,000	349,000	was 349,900 cub. ft., on the 18th
February	393,000	440,000	373,000	the flow measured 191,000 cub.
March	409,000	425,000	373,000	ft. Weather conditions re-
April	987,000	829,000	906,000	mained the same during repairs.

Average daily flow over three years 585,847 ft.=3,661,543 gals.

Collingwood Water Works.

Water pumped as registered year 1912:—

1912	Date.	Gallons.	Totals.
January	1st to 15th...........	11,892,500	24,015,000
"	16th to 31st..........	12,122,500	
February	1st to 15th...........	11,530,000	22,675,000
"	16th to 29th..........	11,145,000	
March	1st to 15th...........	12,135,000	25,812,500
"	16th to 31st..........	13,677,500	
April	1st to 15th...........	12,677,500	24,217,500
"	16th to 30th..........	11,540,000	
May	1st to 15th...........	12,307,500	26,177,500
"	16th to 31st..........	13,870,000	
June	1st to 15th...........	12,452,500	27,385,000
"	16th to 30th..........	14,932,500	
July	1st to 15th...........	14,672,500	28,409,000
"	16th to 31st..........	13,737,500	
August	1st to 15th...........	13,845,000	27,117,500
"	16th to 31st..........	13,272,500	
September	1st to 15th...........	12,785,000	24,835,000
"	16th to 30th..........	12,050,000	
October	1st to 15th...........	12,117,500	25,185,000
"	16th to 31st..........	13,067,500	
November	1st to 15th...........	11,332,500	21,887,500
"	15th to 30th..........	10,555,000	
December	1st to 15th...........	9,850,000	20,240,000
"	16th to 31st..........	10,390,000	
		297,957,500	

816,300 gallons per day.

Chemical Report.

Report on waters received from Dr. Donald McKay, M.O.H., of Collingwood, on the 15th day of April, 1913.

Laboratory Numbers	Sender's Numbers	Where collected from	Free Ammonia	Albuminoid Ammonia	Nitrogen as Nitrites and Nitrates	Oxygen consumed in 5 minutes	Chlorine	Hardness	
								Total	Temporary
1529	......	Town Line Bridge, Silver Creek..	......	......	......	......	1	214	185
1530	......	" " "	......	......	......	......	1	214	185
1531	......	Tap Water	......	......	......	......	2	122	86
1532	....	"	......	......	......	......	2	122	86
1533	......	Osler Spring....................	......	......	......	......	1	220	186

All of which is respectfully submitted.

John A. Amyot.

REPORT *RE* SEPTIC TANK CAPACITY AT BERLIN, ONTARIO.

TORONTO, March 10th, 1913.

During the summer months of 1902, a series of experiments were carried on with reference to the various methods of sewage treatment at Berlin, Ontario. At this time the daily flow approximated 375,000 gallons. The Berlin sewage on account of the large amount of a special kind of tannery waste in it has a character quite different from most other municipal sewages. Eighteen hour treatment gave a reduction of 45 per cent. in the organic matter. Twenty-four hours gave 55 per cent. and this over a period of five months. This 10 per cent. on the top end was considered such an advantage that when the present plant was decided on a twenty-four hour treatment was installed, with the full knowledge that eight hours had been shown to be quite as good as sixteen and twenty-four hours in some other places. This Berlin sewage is a special one, and has probably not materially changed in composition.

The Imhoff method now so generally coming into use is on a different principle. The sludge only is septicized in the trapped under chamber. The upper chamber is simply a sedimentation one and should not be of greater capacity than one hour.

The Berlin tank was designed for a twenty-four hour holding of 450,000 gallons. The second chamber was simply intended as a reservoir to hold the effluent from the septic tank for such time as it would be convenient to put the pumps into commission. (When the city power consumption was below peak.) Another reason for the second tank was that as the quantity of the sewage in the future would increase and the capacity of the first be overtaken, half of the second could then be used as a septic tank, the rest still as a receiving reservoir, and as the quantity grew that the third portion could be used as a septic tank, thus making both original septic tank and reservoir a septic tank system for 900,000 gallons. It is quite probable that that time has now been reached. It was also intended when this full capacity was reached that a small receiving reservoir be constructed to take up the work of the one converted into a septic tank. Of course, pumping will now have to be done over a longer period of time than formerly.

Also it was intended that the filter beds should never be called on to do more than 75,000 gallons per acre on an average per day throughout the year. I am afraid they are being already worked much beyond this capacity. If so and this is continued, there will soon be trouble with them of a serious nature.

So unless some other system of preliminary treatment is to be adopted twenty-four hour treatment should be continued and the number of beds increased so that not more than 75,000 gallons be forced through them.

JOHN A. AMYOT.

THE ICE SITUATION IN LONDON, ONTARIO.

February 24th, 1913.

On account of the scarcity of supply due to mild weather, the ice men of London have been driven to gathering ice in various directions. With Dr. Hutchinson, the Medical Officer of Health, I visited six sources of supply: The Cove, Wilkinson's Pond, Oxford and Adelaide Sts., Syndicate Ponds and the Warwick Pond.

The Cove is a shallow, through which at one time the Thames River ran, but on account of a railroad construction the river has been short circuited, leaving this Cove blocked at either end during ordinary water level. About a month ago the river overflowed and filled this Cove up and all the surrounding land on which are a few houses and some farm property, thus polluting the otherwise fairly clean water of the Cove. The river water probably did not carry very much sewage on account of its great bulk, but there is some doubt as to the quality of the water now in the Cove, and a very large part of London's natural ice supply for the coming summer is being taken out of this. It is general knowledge that water purifies itself to a very large extent in the sedimentation, during crystallization and afterwards by freezing in the enmeshing ice. The flooding took place one month before the cutting of the ice. This, of course, means an additional safety, and though it would be difficult and unjustified to say that this ice source is an absolutely dangerous one, there is still risk in allowing this to be used for domestic purposes, but *of all the sources examined it is the best.*

Wilkinson's Pond is simply an overflow from the Thames River from the north branch. Quite recently there has been a flooding over of the flats and though there are not many houses in the neighborhood draining into this, there are some. Some twenty miles above St. Mary's empties all its sewage into this north branch. The pond is a shallow one. This is a questionable ice source.

The Oxford St., the Syndicate Ponds, and Warwick Pond. All of these ice sources are very questionable in quality, they being just shallow pools in the excavations for the removal of brick clay and earth for other purposes (the very last waters one would choose for a public water supply). Shallow and full of vegetation, it would be very difficult to guarantee the safety of these.

Recommendations.

First, as to the ice from the Cove. This ice is probably safe, just probably, and considering the scarcity of ice might be sold without restriction.

"As to the other sources, I am of the opinion that they should not be used for domestic purposes, merely for cooling and on account of the possible difficulty of confining them to such a use of the ice, it would seem best that the city authorities of London should make engagement that each of those who have removed ice from these sources use it for no other purposes than for cooling, not at all for domestic purposes, otherwise forbid the use of it at all. Such an engagement would give the local health authorities a better hold on these ice vendors."

All of which is respectfully submitted.

John A. Amyot.

REPORT *RE* WATER SUPPLY AND SEWERAGE IN PICTON.

May 14th, 1913.

The visit was made on May 14th, 1913, in company with Dr. G. Clinton, District Officer of Health.

Picton now has a population of over 3,500 and is growing.

The typhoid fever death rate for the whole county during 1910 and 1911 averaged 13.5—not high. The health of the town is reported as generally good.

The houses generally have considerable ground about them. The streets are wide.

The drinking water supply of the town is derived from wells.

The sewage is disposed of by seepage through the ground. There are said to by many cesspools scattered about. Along the streets skirting the harbor and the ravine leading from it storm drains are used rather extensively for domestic sewage drainage.

The town has a water system on the harbor for fire and street watering purposes. It is not used for domestic purposes, and wisely.

So far, there has not been abnormal sickness that could be attributed to overcrowding. But with the growth going on as it is and the future prospects the critical point has been reached or is close at hand. The wells are being threatened now more and more from day to day. The people are requiring more house comforts such as a safe water supply would give them. There is a general demand for such. Many have gone to the expense of putting in private systems, using cesspools, etc.

The town is in a good financial condition, having practically no debt.

Already a report has been made by Mr. Willis Chipman, Engineer, on water supply and sewerage systems. There is no obvious difficulty to either of the recommended plans.

It is proposed to take the water by "water-galleries" from the low sandy land about Trout Creek situated to the south-west of the town. The quantity of water in sight seemed to be sufficient. The Engineer is convinced it is. It is of good quality physically. From the sanitary standpoint if it is taken by galleries, it can be used safely without treatment. In the event that the soil was found unsuitable for a big supply by galleries, filtration or some satisfactory method of purification would be necessary. It would not be safe to take it directly from the stream of the catchment area. The quantity of water available is not so great as at Simcoe, but is otherwise practically a duplicate of it.

Other sources of supply have been mooted. *Picton Harbor* runs too much risk of pollution, also the sewage will ultimately have to be discharged into it.

West and East Lakes are distant, and the water would have to be purified.

The Lake on the Mountain—This was proposed chiefly because it was thought to be a possible gravity supply. It is not elevated sufficiently to give such a sort of supply. It is not inexhaustible either.

Other Springs. None of them seems to supply a sufficient quantity of water.

All things considered Mr. Chipman's recommendation of the Trout Creek supply seems the best.

If this water supply is put in and it seems really a necessity it will become imperative that sewerage be installed and if it is possible both the water system and the sewerage system should be constructed at the same time.

The town is so well situated topographically that practically the whole system can be made to end at one point for disposal. In view of the fact that the harbor is not to be used as a source of drinking water satisfactory sedimentation with proper treatment of sludge and discharge of the partially clarified effluent into the harbor at a distance from the wharves would seem, for the present at least, to be sufficient to answer. Chlorination of this effluent would be a decided advantage.

I deem it unsafe for Picton to delay longer the installation of a municipal domestic water supply, a sewerage system and a treatment plant at the outfall before final discharge into the harbor.

All of which is respectfully submitted.

JOHN A. AMYOT.

REPORT ON THE WATER SITUATION IN DUNDAS.

July 17th, 1913.

A visit was made to Dundas on July 17th, 1913. The present water supply of Dundas is from Enright's Creek. In dry summers the supply is scant, hardly enough to meet the present needs. Last year the dam was washed out. A new dam would be required in order to continue the use of the present source. To provide for future increased quantity, and the town is growing rapidly, a dam of greater magnitude than the old one would be required, and more land would be required also, for storage to carry over dry summers. When all this is done the supply will still be a small one.

There is a feeling amongst those concerned that no more money should be spent on the present plant. Some have suggested that the present source be abandoned and the supply be taken from the Desjardins Canal.

This canal runs from Hamilton Bay under the railroad tracks through low lying land usually covered with water, into Dundas about two miles away. The greater part of the Dundas end is banked. The eastern end is through open water. There is open water on both sides of the Canal. The greater portion of open water is on the south side. The Dundas Creek after winding through the town empties into the open water on the south side of the canal and through breaks in the bank communicates with the canal. Into the south east corner of the open water empties a small creek and the effluent from the Hamilton Asylum and a large Hamilton sewer. The water of this swamp, for it is really a big swamp, does not look right. The water in the canal is a little better, but is turbid, contains a good deal of organic matter and must show a considerable algae growth in the heated season. It could be purified by careful mechanical filtration and then made safe by continuous and careful disinfection by chlorination. It could not by any means be used without this. It will be warm at times. It will have algae odors at times also, in spite of the purification. The original will be so continuously under the eyes of the citizens, the canal ending in the town as it does, that it will always be held under suspicion no matter how fine the finished product might be.

The quantity will always be adequate for it will be made up from Hamilton Bay and the swamps and must at times have a considerable amount of polluting matter in it for the purification plant to remove.

If all polluting matter were prevented entering the swamp and Hamilton Bay, there would still remain the swamp character of the water.

Altogether it does not seem a desirable source unless there is no other.

Some have suggested deep wells. There is no large quantity of water in the red medina shale. In the Utica and the lower limestone good water has been obtained, but most frequently the water is sulphuretted or salty or both and very hard. One would hardly like even to advise spending money required for a test, the chances are so small of succeeding.

Dundas has now reached such a size, the population is so congested, the demand for house conveniences so increased, that in the interest of public health it is necessary to provide sewerage for the town. If the sewage were discharged raw directly into the canal, this would be fouled beyond endurance, if discharged into the swamp in the same condition it would damage the water to such an extent that even though it were put in at the most distant point possible all consideration of the canal water as a source of water supply would have to be adandoned.

In any case treatment of the sewage would be needed. If the canal water is to be used as a source of water supply the sewage would have to receive considerable

treatment even to the point of disinfection, but Dundas is favored in this direction, for on the north side of the canal is high land made up of such sand and gravel as would make it possible to treat the sewage by intermittent sand filtration. Pumping would be required, but the lift would not have to be great. The effluent could almost without disinfection be discharged into the swamp and not damage the canal water to so great an extent that it could not be safely purified by the filtration and disinfection above spoken of.

Now, from the fact that Dundas will have finally to discharge its sewage into the swamp, and that the sewage of the asylum and of a portion of the City of Hamilton is being discharged into it, and that any replacing water will have to be drawn from Hamilton Bay, where already sewage is entering, and also as the water of the Desjardins Canal without these polluting sources is not an extremely desirous water supply, other sources ought to be considered.

A pipe line to Lake Ontario would cost a great deal. It would seem, everything considered, that the best plan would be for Dundas to enter into some arrangement with the City of Hamilton for an extension of their system into Dundas. Hamilton will soon have to supply water to an intermediate suburb. Hamilton's present system is taxed, but it will soon have to be increased in any case—the city is growing so rapidly.

If the Desjardins has to be resorted to as a source of supply for Dundas, it will become necessary for Hamilton to treat their sewage much more exhaustively than if the canal were not used as a source of water supply.

JOHN A. AMYOT.

Reports of Branch Laboratory at Kingston, and Laboratory of Institute of Public Health, London, Year 1913

REPORT FROM LABORATORY OF PROVINCIAL

Municipalities	Diphtheritic swabs				Tuberculous sputa		Typhoid bloods		Pasteur preventive treatment		Rabies diagnosis			
	Release		Diagnosis									Negri bodies		
	+	−	+	−	+	−	+	−	Cases	Number of injections	Animal	+	−	Animal inoculations
Brant Co.—														
Brantford														
Bruce Co.—														
Paisley				1		1	1	1						
Carleton Co.—														
Manotick				1	1			1						
N. Gower							1	2						
Ottawa			2	2	3	8	12	25						
Richmond					1	1	2	3						
Vernon						1	3	3						
Dundas Co.—														
Brinston						1								
Chesterville					1	2	1	1						
Morrisburg					2	2		4						
Winchester				1	4	8	1	7						
Elgin Co.—														
St. Thomas														
Frontenac Co.—														
Barriefield														
Arden							1							
Flinton					1	1								
Harrowsmith			2	19	1	6	4	11						
Inverary			3	9										
Kingston	122	224	79	238	53	232	63	227						
Mountain Grove														
Portsmouth				3	88	20	4	11						
Sharbot Lake					10	3	1	2						
Sydenham					1	1	3	3						
Verona				1	2	1	3	7						
Wolfe Island				1	1		1	2						
Glengarry Co.—														
Alexandria					4	3								
Dalhousie Mills						2								
Dalkeith					1	1								
Lancaster	3	2	2	1	1									
Maxville				2		5		2						
Williamstown					4	12								
Grenville Co.—														
Cardinal						3								
Jasper				2			1	1						
Kemptville				1		4	1	1						
Merrickville	1		1	2	2	1								
N. Augusta					1	1								
Prescott			1	1			6	6						
Spencerville				3	2	3								
Haldimand Co.—														
Hagersville														
Haliburton Co.—														
Wilberforce					1									
Hastings Co.—														
Bancroft						8	1	6						
Belleville	1	1	4	9	2	1		2						
Frankford	2	5		1										
Hastings					1	1		1						
Madoc					1	5								
Marlbank					2	1								
Roslin				3	3	4	1	6						

BOARD OF HEALTH AT KINGSTON FOR YEAR 1913.

Milk										Waters.		Liquors for License Dept.	Doses of Typhoid Vaccine sent out.	Miscellaneous Specimens.	Total	Outfits sent out.				
Food Content.		Preservatives.		Bacteriological.																
				Tubercle Bac.		Pus cells.														
Fats.	Total Solids.	+	−	+	−	+	−	Count.	Extraneous matter.	Chemical.	Bacterial.					Water.	Diphtheria.	T.B.	Typhoid.	Total.
											2				2					
															4					
															3					
															3					
															52					
															7					
															7					
															1					
															5					
															8					
															21					
														1	1					
											4				4					
															1					
															2					
											8				51					
											4				16					
3	3		3		4		4	6	6		257			107	1631					
											2			24	26					
											10			22	158					
											3			6	25					
														1	9					
											27			1	42					
											1				6					
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															7					
															7					
					1		1	1	1		15				33					
															8					
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											3				3					
															1					
															15					
														1	21					
															8					
															3					
															6					
															3					
															17					

Report from Branch Laboratory of Provincia

Municipalities	Diphtheritic swabs: Release +	Diphtheritic swabs: Release −	Diphtheritic swabs: Diagnosis +	Diphtheritic swabs: Diagnosis −	Tuberculous sputa +	Tuberculous sputa −	Typhoid bloods +	Typhoid bloods −	Pasteur preventive treatment: Cases	Pasteur preventive treatment: Number of injections	Rabies diagnosis: Animal	Rabies diagnosis: Negri bodies +	Rabies diagnosis: Negri bodies −	Rabies diagnosis: Animal inoculations
Hastings Co.—Continued—														
Shannonville					1	3	1	2						
Stirling					1	1	1							
Trenton				2		3								
Tweed					1	3		1						
Huron Co.—														
Wingham						4	1	13						
Kent Co.—														
Blenheim								1						
Chatham						1								
Lanark Co.—														
Almonte				2		4								
Balderson														
Lanark			1	1										
Perth			1	1	3	1		1						
Smith's Falls			6	14	4	10	4	8						
Leeds Co.—														
Athens				1		2	1							
Brockville	8	3	3	10	10	26	21	20						
Delta					2	1		1						
Elgin					2		2	1						
Frankville					1									
Gananoque				1	2	9	1	2						
Lansdowne				3	1	9	14	23						
Lyn				2		1								
Mallorytown			2	7		3		7						
Newboro						1								
Seeley's Bay				3		3								
Westport					1	1	1	2						
Lennox and Addington—														
Bath						3								
Denbigh						1								
Deseronto					1									
Dorland						2		1						
Enterprise					1	8	1	4						
Napanee				1	5	24	10	15						
Newburgh			1			2	1							
Odessa						1	1	4						
Stella														
Tamworth					1	2								
Yarker				1	1	2	4	10						
Manitoulin Dist.—														
Gore Bay					1									
Northumberland Co.														
Campbellford				1		2	3	1						
Castleton							2	3						
Cobourg														
Port Hope				1	2	11		2						
Roseneath				2				4						
Peterboro Co.—														
Lakefield						1								
Peterboro					2	3	1	2						
Prescott Co.—														
Fournier					11	2	3	2						
Hawkesbury					1	1		1						
St. Eugene						4		1						
St. Isidore						1								
Vankleek Hill						1								

Board of Health. Kingston, for Year, 1913.—Continued.

Milk										Waters.		Liquors for License Dept.	Doses of Typhoid Vaccine sent out.	Miscellaneous Specimens.	Total	Outfits sent out.				
Food Content.		Preservatives.		Bacteriological.					Extraneous matter.											
				Tubercle Bac.		Pus cells.														
Fats.	Total Solids.	+	−	+	−	+	−	Count.		Chemical.	Bacterial.					Water.	Diphtheria.	T.B.	Typhoid.	Total.
															7					
														1	4					
														1	6					
											3				8					
											2				20					
															1					
															1					
														2	8					
														2	2					
															2					
											36				43					
														1	47					
											3				7					
1	1		1		1		1	1	1		35			2	145					
											1				5					
															5					
															1					
											9				24					
											8			1	59					
											1				4					
											1				20					
															1					
															6					
															5					
											7				10					
															1					
															1					
															3					
															14					
											41			3	99					
															4					
											1				7					
											1				1					
															3					
											22				40					
															1					
															7					
															5					
											1				1					
															16					
															6					
															1					
											2				10					
														1	19					
															3					
															5					
															1					
															1					

Report from Branch Laboratory of Provincial

Municipalities	Diphtheritic swabs: Release +	Diphtheritic swabs: Release −	Diphtheritic swabs: Diagnosis +	Diphtheritic swabs: Diagnosis −	Tuberculous sputa +	Tuberculous sputa −	Typhoid bloods +	Typhoid bloods −	Pasteur preventive treatment: Cases	Pasteur preventive treatment: Number of injections	Rabies diagnosis: Animal	Rabies diagnosis: Negri bodies +	Rabies diagnosis: Negri bodies −	Rabies diagnosis: Animal inoculations
Prince Edward Co.—														
Picton					3	8		1						
Wellington					3	5								
Renfrew Co.—														
Arnprior						1								
Calabogie					1	2	1	4						
Cobden				2	6	14	6	3						
Douglas				2		2	1							
Forester's Falls						1								
Pembroke				1	5	14								
Renfrew	2	2	5	11	11	30	2	4						
Westmeath			1	1		1	1	1						
Russell Co.—														
Cumberland				2										
Metcalfe				6	2	11	3	15						
Simcoe Co.—														
Barrie				4	3	4	10	11						
Stormont Co.—														
Aultsville			1	1		1								
Avonmore				1		1								
Cornwall						3	1	1						
Finch						4								
Newington					2	9		10						
Timiskaming Dist.—														
Cochrane					1	1		1						
Thunder Bay Dist.—														
Fort William														
Port Arthur							1							
Victoria Co.—														
Lindsay					2									
Waterloo Co.—														
Preston					1	2								
Welland Co.—														
Niagara Falls					1									
Thorold														
York Co.—														
Toronto				1										
Total	139	237	115	385	290	614	210	519						

Board of Health, Kingston, for Year, 1913.—Concluded.

Milk: Food Content: Fats.	Milk: Food Content: Total Solids.	Milk: Preservatives: +	Milk: Preservatives: −	Milk: Bacteriological: Tubercle Bac.: +	Milk: Bacteriological: Tubercle Bac.: −	Milk: Bacteriological: Pus cells: +	Milk: Bacteriological: Pus cells: −	Milk: Bacteriological: Count.	Milk: Extraneous matter.	Waters: Chemical.	Waters: Bacterial.	Liquors for License Dept.	Doses of Typhoid Vaccine sent out.	Miscellaneous Specimens.	Total	Outfits sent out: Water.	Outfits sent out: Diphtheria.	Outfits sent out: T.B.	Outfits sent out: Typhoid.	Outfits sent out: Total.
											2				14					
															8					
											18				19					
											2				10					
											30			1	62					
															5					
															1					
											1				20					
															68					
															5					
															2					
														1	38					
														2	34					
															3					
															2					
											1				6					
															4					
															21					
															3					
														1	1					
															1					
															2					
															3					
															1					
														1	1					
															1					
4	4		4		6		6	8	8		248	316		183					32	96

REPORT FROM LABORATORY OF INSTITUTE OF PUBLIC HEALTH,

Municipalities	Diphtheritic swabs				Tuberculous sputa		Typhoid bloods		Pasteur preventive treatment		Rabies diagnosis			
	Release		Diagnosis											
	+	—	+	—	+	—	+	—	Cases	Number of injections	Animal	Negri bodies +	Negri bodies —	Animal inoculations
Alvinston			1	1										
Appin				2		4								
Arkona				1				2						
Barrie							1	1						
Belmont						2								
Blenheim			2	1			2							
Brucefield				2										
Camlachie						1		1						
Cayuga														
Chatham			1	1	3	13		4						
Clinton				1	1									
Dresden						1								
Fingal						1								
Glencoe		4		1		4								
Glenwood						1								
Harrow			1											
Ingersoll					1			2						
Inwood							2							
Kingsville														
Kirkton				3										
Lakeside						1								
Lambeth					5	2								
Lawrence				1										
London	3		2	20	27	28	21	29					1	
Mount Brydges					1	1								
Newbury					2									
New Hamburg			1					1						
Parkhill								1						
Port Stanley						2		1						
Ridgetown				1	1									
St. Mary's	5	4	2			6								
St. Thomas								1						
Sandwich														
Simcoe			1											
Springfield		1												
Stratford				2		1								
Tavistock								3						
Walkerville	1		1	1										
Wallaceburg					1	3	2	1						
Watford						1								
Wheatley								3						
Wingham														
Woodstock						1		3						
Wyoming			1	1										
Zurich							1	1						
Total	9	9	13	39	42	73	29	54					1	

LONDON, FOR PERIOD APRIL TO DECEMBER, 1913.

Milk: Food Content: Fats.	Milk: Food Content: Total Solids.	Milk: Preservatives: +	Milk: Preservatives: —	Milk: Bacteriological: Tubercle Bac.: +	Milk: Bacteriological: Tubercle Bac.: —	Milk: Bacteriological: Pus cells: +	Milk: Bacteriological: Pus cells: —	Milk: Bacteriological: Count.	Milk: Extraneous matter.	Waters: Chemical.	Waters: Bacterial.	Liquors for License Dept.	Doses of Typhoid Vaccine sent out.	Miscellaneous Specimens.	Total	Outfits sent out: Water.	Outfits sent out: Diphtheria.	Outfits sent out: T.B.	Outfits sent out: Typhoid.	Outfits sent out: Total.
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...
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48	...	...	43	...	...	...	...	14	...	17	29	...	...	...	282	...	...	...	...	...
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50	2	...	45	...	...	...	...	16	...	37	59	...	...	...	478	...	...	...	...	...

Provincial Board of Health of Ontario
Experimental Station

BULLETIN No. 2.

REPORT UPON THE PURIFICATION OF SEWAGE

By A. V. DeLAPORTE, B.A.Sc.

STUDIES IN THE BEHAVIOUR OF MECHANICAL FILTERS, INCLUDING ANALYTICAL DATA

By C. S. ROBERTSON, B.A.Sc.

STUDIES IN THE DISINFECTION OF SEWAGE BY CALCIUM HYPOCHLORITE, INCLUDING DIAGRAMS

By C. R. AVERY, B.A.Sc.

BULLETIN NO. 2.

Experimental Station.

To the Chairman and Members Provincial Board of Health, Ontario.

Gentlemen,—I have the honour to transmit herewith Bulletin No. 2 of the Experimental Station, which gives the results of investigations relating to the disinfection of sewage, the behaviour of mechanical filters, with special reference to operation and bacterial removal, and a summary of the results relating to the purification of sewage.

Your obedient servant,

F. A. Dallyn.

INTRODUCTION.

The operations at the experimental station for the year 1913 were seriously interfered with by the fact that, upon request of the International Joint Commission and through the courtesy of the Provincial Secretary, the staff and apparatus in connection with the experimental station were utilized in the International Boundary Waters Pollution Investigation. The work incident to this investigation was not completed until September. It was thought advisable at that time to retain the services of Messrs. Avery, Parkinson and Robertson who were employed by the Board for the purposes of the Commission. Mr. A. V. DeLaporte, B.A.Sc., a graduate in chemistry of the Faculty of Applied Science of the University of Toronto, who had previously been in our service, was made responsible for the conduct of operations at the experimental station. The re-arrangement of the Laboratory was undertaken in September and required about a month for its completion. The completed arrangement is shown in the photographs. It then became possible to examine a very increased number of samples bacteriologically per day and permitted two men to devote their entire time to bacteriological investigation alone. In order to relieve the laboratory at No. 5 Queen's Park, it was deemed advisable to prepare all the media in connection with this work at the experimental station itself. New apparatus was also purchased in connection with the chemical department making it possible to analyze sludge and to determine its calorific value and other information necessary in connection with its proper disposal.

Another sewage distributor was purchased to study the effect of high rates upon the action of biologic filters. The results from this investigation, however, will not be available until the report for 1914 is published. It is anticipated, however, that rates of filtration for biologic filters should not exceed as a maximum 2,500,000 gallons per acre per day. Some interesting facts in connection with this type of distributing filter were discovered and will be made public in the report for 1914.

Having in mind the possible advantages of some of the other types of distributors of sewage on biologic filters, advantage was taken of the situation at Kingston and when the Board was asked to prepare plans for the sewage disposal plant at Rockwood Hospital for the Insane, the water-wheel type of distributor was recommended chiefly in order that experimentation might be made which could not readily be carried on at the experimental station at Toronto. The distributor, which

The Provincial Board of Health Experimental Station, Clifford Street, Toronto, Ont.

will be tested out, is propelled by a discharge over a water-wheel—the discharge being controlled by a syphon and weir—and operates over an area 37 feet by 135 feet, dealing with approximately 125,000 gallons per day.

The results obtained in connection with the biologic disposal of sewage (examinations to determine which were carried on from 1911 to the present writing) have been put in order by Mr. DeLaporte, whose report is included herein, and show that the operation of the Imhoff tank—the construction of which was completed in the month of April, 1912—has been most successful. This tank is not a true Imhoff in that it is much shallower than that recommended by Dr. Imhoff. Its operation, however, is identical with that of the tanks which have been erected in Germany; the sludge obtained from this tank has a similar analysis to that of the German sludge and also similar to that obtained from the experimental units which have been installed in the United States. The sludge dries rapidly in two or three days and gives rise to no disagreeable odors; when taken outside and thrown in mounds, it did not appreciably take up water more than ordinary loam, and drained rapidly. For these reasons it seems that the sludge would make excellent fill, its moisture content after several weeks not being much higher than that of ordinary loam.

The work in connection with the disinfection of sewage was delegated to Mr. C. R. Avery, B.A.Sc., a graduate of the Faculty of Applied Science of the University of Toronto, and employed in the capacity of assistant engineer. His report upon the work appears herein and deals mainly with the phenomena presented by the application of bleaching powder to sewage of different characters. It will be noted in this report that the disinfecting action takes place very rapidly, usually within a period of twenty minutes, and in the higher quantities within a period of seven minutes. It is altogether probable that with such rapid action the chemical disinfects the liquid sewage before attacking the particles in suspension. It is probable that in the installation of sewage chlorinating apparatus the disinfectant should be applied before sedimentation instead of subsequent to sedimentation, thus making a radical change in the present design. In view of the probable recommendations arising out of the International Joint Commission's report, this work of Mr. Avery will be most valuable.

Work upon the mechanical gravity filter. This unit was installed at the experimental station in 1912 but was not regularly operated until the fall of 1913. To Mr. C. S. Robertson, B.A.Sc., a graduate of McMaster University and of the Faculty of Applied Science of the University of Toronto, was delegated the research work upon this unit. His report appears herein and deals mainly with bacterial efficiency consequent upon the normal or careless handling of a mechanical filter. It was deemed advisable for the purposes of this report to develop this fact most strikingly: *"That an improperly operated mechanical filter does not afford a very adequate protection of a seriously polluted water supply."* Mr. Robertson's report covers a great deal of ground and shows that, for Toronto water infected by adding sewage (similar to our experiments with the slow sand filters), the efficiency of the filter unit was somewhat less than that for slow sand filters (Bulletin No. 1), despite the fact that considerable alum was used with the raw water. While the possibility of organic growth in the filter may have had considerable influence on the results, one fact is most clearly emphasized, viz., as determined by B. Coli determinations the filter effluent counts are subject to considerable variation. From our observations, a mechanical gravity filter operated with a filter media about five feet deep is a very sensitive instrument and requires a great deal of care for its efficient operation.

It is recommended that upon completion of our work upon the mechanical filter a unit of the Ver Mehr type be purchased and experimented with to determine its reliability and the factors affecting its efficient operation. Experiments with each type of purification apparatus seem advisable in view of the very widespread pollution of the International Boundary waters, which will require remedial measures in the very near future. A report of such work could probably be undertaken and presented in the annual report for 1915; possibly the work could be rushed and included in the report for 1914.

Realizing the necessity of anticipating the public demand for some type of sterilization which, while having all the advantages of chlorine for effectiveness, would not present objectionable features such as tastes and odor, it was thought advisable to experiment with one of the newest apparatus for the sterilization of water, viz.—the Ultra Violet Ray. Apparatus was ordered and received from France and more recently additional apparatus (a larger unit) has been ordered from New York in connection with this installation. It is anticipated that the investigations relating to this work will be completed some time in the fall of 1914 and will appear in the annual report for that year.

F. A. Dallyn.

This portion of the Laboratory is arranged for Bacteriological Work. Experimental Station, 1913.

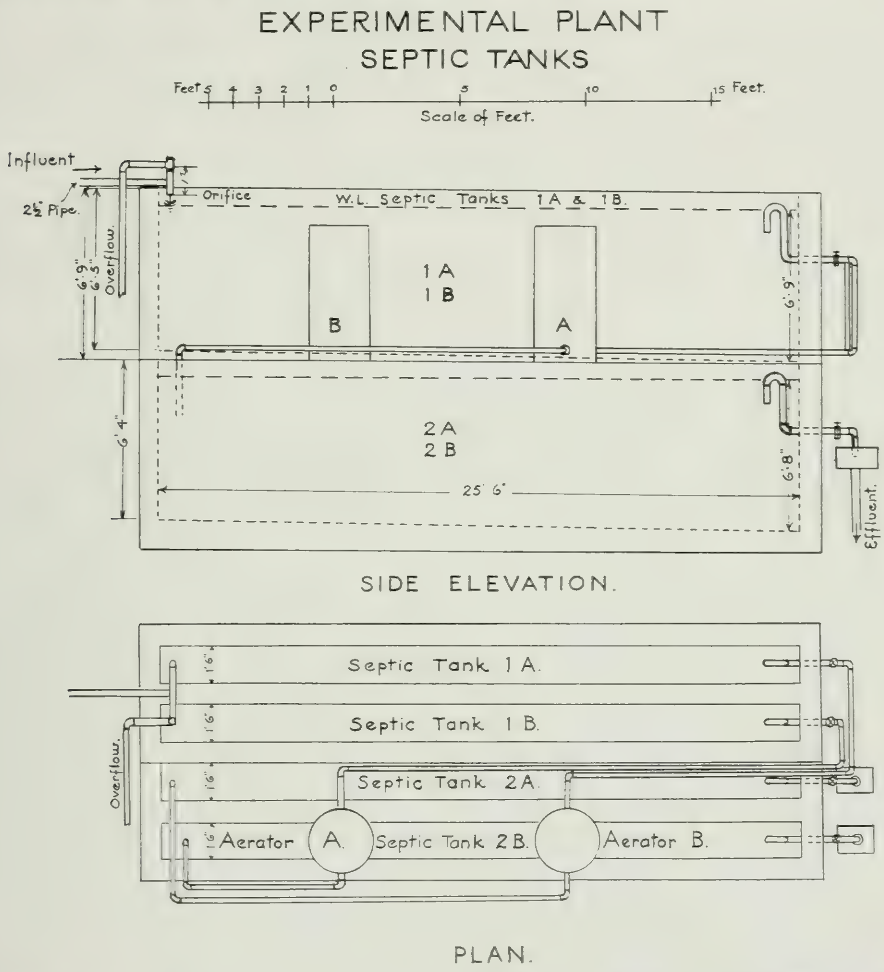
The Laboratory where Chemical Data is collected to aid municipalities in their Sewage Disposal problems. Experimental Station, 1913.

REPORT UPON THE PURIFICATION OF SEWAGE.

A. V. DeLaporte, B.A.Sc.

Septic Action.

The septic tank and biological digestion of organic matter in sewage has received considerable attention in both Europe and America. All of the work done seems to have been with raw sewage, so that the improvement in character of the

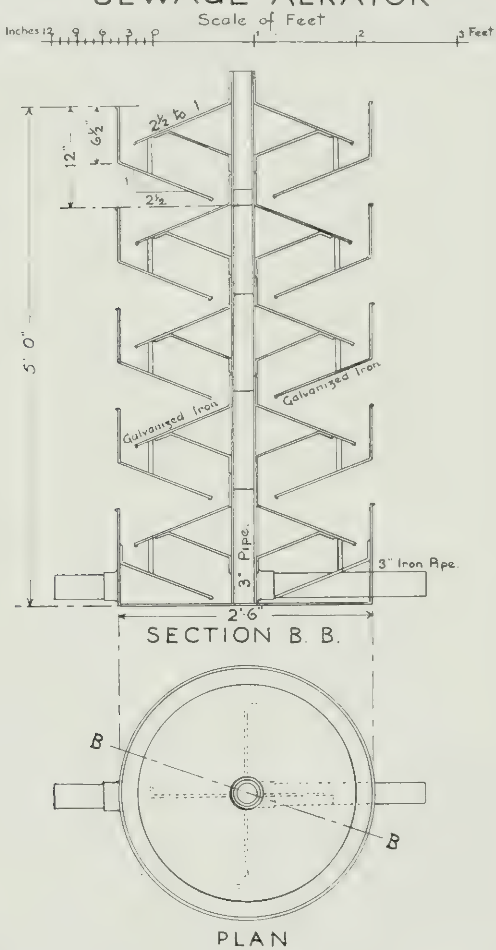


sewage has been due to sedimentation, as well as to biological digestion. Both chemical and physical analyses of the effluents from such tanks, unfortunately, have been influenced by the effect of sedimentation and did not give a true measure of the efficiency of biological digestion. It therefore seemed advisable to do some work with septic tanks, precluding any improvement by sedimentation, by the use of a settled sewage. At first the effluent from a settling tank was used: later the work was done with an Imhoff effluent. Consequently, any improvement in character in the sewage was due to the septic digestion of the semi-colloidal and colloidal matter in the sewage—not to an improvement by sedimentation of solids in sus-

pension. In connection with this work two batteries of tanks were operated to find the optimum length of storage for and the effect of aeration on septic sewage.

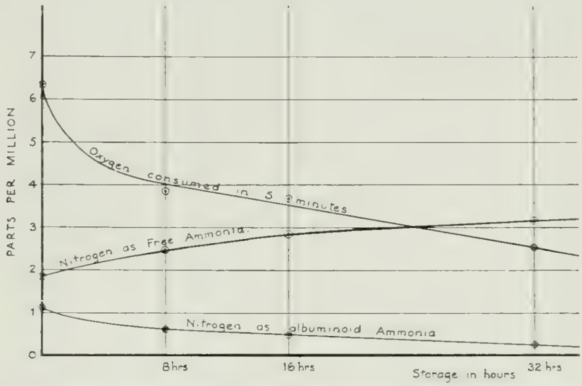
The four tanks used were of concrete, 25 feet long by 1 foot 6 inches wide and 6 feet deep, and were so arranged that the effluent from the first two tanks would flow over aerators before entering the second pair of tanks. Baffles were fitted at suitable points to prevent currents and movements of scum or sludge. The sewage was fed through an orifice under constant head. The effluent overflowed from a foot below the surface through a pipe shaped like an inverted U with an air hole to prevent syphoning. The aerators are shown in section and plan.

SEWAGE AERATOR



In septic tanks particles of sludge attached to gas globules are constantly rising and particles of scum settling. These find their way from time to time into the effluent. Consequently the suspended matter in the effluent varies considerably. This causes large variations in the chemical analysis, necessitating frequent sampling over a long period to find the real efficiency of a unit. To prevent part of the sludge from passing away in the effluent is impossible, but if the sludge be removed from time to time it will help the unit to maintain its maximum efficiency. It is suggested that where tanks are neglected and become full of sludge the length

of storage of the sewage is cut down until the effluent has really not been subject to septic action; in passing through the tank it has become charged with particles of digesting sludge, so that it might possibly be as bad, if not worse, than the original sewage. Curves showing normal effect of storage in septic-tanks have been drawn from data obtained at the experimental station.



CURVES SHOWING EFFECT OF STORAGE IN SEPTIC TANKS

Average Analyses showing the Action of Septic Tanks with different periods of storage.

	Nitrogen as Free Ammonia.	Nitrogen as Albuminoid NH_3.	Oxygen consumed in five minutes.
Influent	19.17	11.5	64.0
8 hours storage	24.6	6.37	38.5
16 hours storage	28.7	5.24	36.75
32 hours storage	31.5	2.79	25.4

June 2nd–Aug. 16th, 1911.

In order to find the improvement in the character of the dissolved solids, a series of analyses was run on the sewage, the sample being filtered with Aluminium Cream.

Showing Improvement in Dissolved Matter in Sewage in Passage through a Septic Tank.

	Nitrogen as Free Ammonia.		Nitrogen as Albuminoid Ammonia.		Oxygen Consumed.	
	Original Sample.	Filtered.	Original Sample.	Filtered.	Original Sample.	Filtered.
Influent	26.6	25.84	7.3	2.7	32.3	15.1
32 hours storage	30.8	25.8	6.03	2.6	23.2	7.5
32 hours storage (aeration)	28.2	27.6	3.6	2.4	21.9	7.6

From July 5th–25th, 1912, 11 samples.

The aerators were used between two periods of storage. After one period of storage the sewage was passed over an aerator and then into another storage tank. It was hoped a great improvement would result, due to a constant inoculation of the second storage tank with certain types of organism, thus ensuring a more constant action in the second tank. That this inoculation takes place is easy of proof, but the improvement in the character of the effluent was so small as to be negligible if measured by Free Ammonia, Alb. Ammonia and Oxygen Consumed tests. The results were:

Average Analyses showing the effect of Aeration.

	Nitrogen as Free Ammonia.	Nitrogen as Albuminoid NH_3.	Oxygen consumed.
Influent	19.17	11.5	64.0
8 hours storage before aeration	24.6	6.37	38.5
Immediately after aeration	23.7	5.2	33.2
8 hours storage after aeration = 16 hours	29.4	4.51	27.8
16 hours storage	28.7	5.24	36.75
16 hours storage immediately after aeration	26.6	4.36	29.5
16 hours after = 32 hours	31.5	2.79	25.4

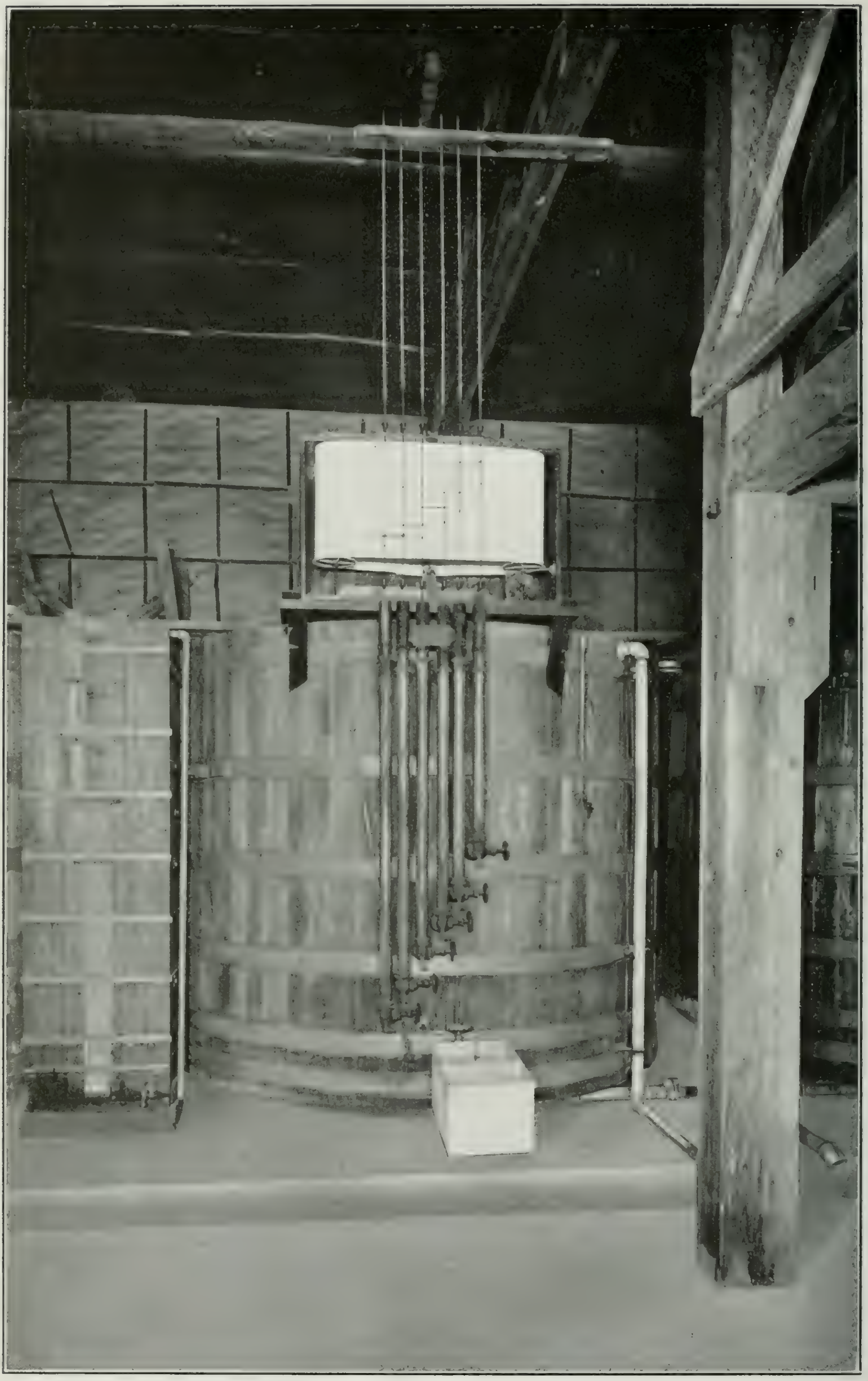
June 2nd–Aug. 16th, 1911.

Another Period Comparing Aerated and Non-Aerated Septic Action.

Influent	27.5	12.7	62.0
16 hours before aeration	33.8	3.31	33.25
Immediately after	31.4	3.92	27.2
16 hours after = 32 hours ... *aerated*	35.5	2.4	25.9
32 hours storage, no aeration ... *non-aerated*	57.0	2.42	25.6

Sprinkling Filters.

The results of analyses of consecutive samples of effluent from the sprinkling filters showed surprising variation, particularly in the amount of oxygen consumed in 5 minutes. This was found to be due entirely to the suspended matter in the effluent. Some samples seemed to be entirely different when analyzed immediately after shaking, but on analysis after settling showed no practical difference. The amount of flocculent and easily settled matter in the effluent made large differences due to the rapidity with which it takes oxygen from Potassium Permanganate and also partly to every variation or error being multiplied by 10; thus, a comparatively slight variation in the amount of permanganate used assumed large proportions when multiplied by 10—one drop would become nearly 0.5 cc. These factors must be taken into consideration, and in order to know what work a unit is doing it is necessary to have a true average of a large number of analyses of samples taken at short intervals and extending over a considerable period.



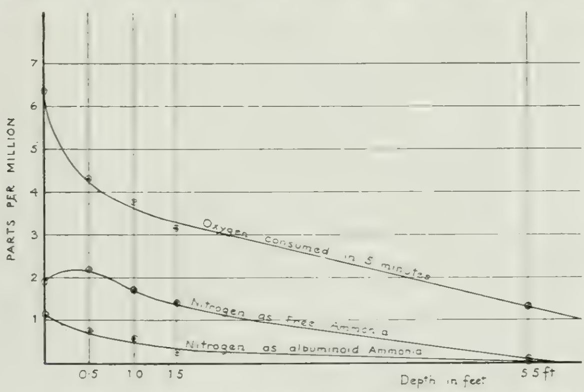
Apparatus arranged to record automatically the Resistance Changes in Filter Media.
Experimental Station, 1913.

Average Analyses of Sprinkling Filter (Crushed Stone).

	Nitrogen as Free Ammonia.	Nitrogen as Albuminoid Ammonia.	Oxygen consumed in 5 minutes.
Influent	19.17	11.5	64.0
Effluent when working well	10.16	4.6	24.7
Effluent when working badly	24.04	5.6	47.4

Note—Both Alb. Amm. and Oxygen consumed are effected by humus in the effluent.

An examination of the surface of the sprinkling filter under normal conditions showed each separate piece of stone to have a thin covering of organic growth. Periodically, however, the surface of the filter became practically covered with fungal growths, usually Beggiatoa Alba. Then it became necessary to stop the filter and allow it to rest and dry for a couple of days. This treatment seemed all-sufficient and no trouble would be experienced from this cause for a considerable period. The sewage used on this bed was an effluent from an Imhoff tank. The



CURVES SHOWING EFFICIENCY AT DIFFERENT DEPTHS OF MEDIA IN A BROKEN STONE PERCOLATING FILTER

tank containing fresh sewage quite possibly assisted inoculation with the organism, one cycle growing at the edge of the Imhoff tank which varied 3 inches in level between each throw in of the pump, and this with the ideal condition for the growth existing on the surface of the sprinkling filter, led to a heavy growth. By stopping the filter the humidity of the atmosphere immediately over the surface was changed, stopping further growth and the worms and micro-organisms in the bed destroyed the growth already there. What would happen to a bed if this growth was not destroyed but allowed to continue on the bed was then the problem. We found that the growth over the bed became almost water-tight, the sewage pooling on the surface. The micro-organisms living on the fungus destroyed the old growth but a new growth kept constantly forming on the surface precipitating upon decay a humus which filled the interstices of the stone under the fungus until the original surface of the bed was covered by several inches of organic matter. The conditions in the bed, instead of being aerobic became anaerobic. Analysis of the gas in the bed showed entire absence of oxygen and the effluent on analysis showed the oxygen consumed in 5 minutes to be double that of a corresponding effluent from a properly working filter. In fact, except for the exceptionally large amount of suspended solids the effluent was not unlike that of a septic tank. An investigation of the condition inside the filter at this stage showed that the humus was generally distributed throughout the filter.

What is the effect of depth in the action of a sprinkling filter? To answer this question troughs were placed at different depths—7 in., 13 in. and 18 in.—in the bed and a series of analyses run on the effluent at these depths for comparison with the final effluent which had passed through 5 feet 6 in. of stone.

Analyses of Sewage during passage through a Sprinkling Filter
(46 Average Analyses—May 16th to September 19th, 1912).

	Free Ammonia.	Albuminoid Ammonia.	Oxygen Consumed.
Raw Sewage	19.17	11.5	64.0
After 6 inches	22.2	7.7	42.6
After 12 inches	17.5	6.1	37.6
After 18 inches	14.0	4.1	31.3
At 5½ feet	7.5	1.9	12.6

These results show that the improvement in the sewage is much greater in the first 6 inches than in the second, and greater in the second 6 inches than in the third, and greater in the first foot and a half than in the ensuing four feet. Would there be any advantage in exceeding the 5½ feet depth?

Effluents from sprinkling filters contain suspended matter at all times. The amount of suspended matter in one bed reached a proportion as high as 10 cubic yards per million gallons of sewage for a short period. This was exceptional; the average bed would probably not exceed more than a cubic yard per million gallons. Periodically, however, the beds slough off a large amount of humus-like material filled with worms and low forms of life. A cubic yard of this material is capable of taking all the dissolved oxygen from 50,000 gallons of water saturated with oxygen at 14 degrees C., or the amount of oxygen in over 4,000 cubic feet of air. This matter turned into a body of water would probably produce anaerobic conditions; this means the destruction of the original life in the water and the production of disagreeable odours.

To safeguard against a nuisance produced in this manner, it is necessary to treat the effluent from bacterial beds. Our experience shows that this material is easily sedimented. One hour's storage in an ordinary sedimentation bed removed practically all suspended matter; in twenty minutes the settlement of all the grosser matter had taken place, only very finely divided matter remaining in suspension. This would be readily retained in an Imhoff tank.

The sludge collected in the sedimentation tanks, used in connection with the sprinkling filter effluent has some very objectionable features. It does not dry readily and has a most unpleasant odor, due probably to the large number of dead worms in it. On storage, under the conditions obtaining in the storage chamber of an Imhoff tank, it would become very similar to an ordinary Imhoff sludge, non-odorous and readily drying. Therefore, the best type of sedimentation tank would be the double chamber type, giving a length of storage of at least twenty minutes in the upper chamber and from one to three months in the lower chamber.

Analyses of Sludge in Effluent of Bacterial Beds
Fertilizer Constituents.

Total Nitrogen	6.8 %
Total Phosphoric Acid	0.8 %
Potash	0.16 %
Grease	6.0 %
Ash	41.7 %

This incubator is large enough to contain 105, daily routine, samples of water or sewage. Experimental Station, 1913.

Incubator arranged for low temperature growth. Experimental Station, 1913.

THE PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION OPERATING DATA.

TABLE I.

Chemical changes during Sewage Purification—Septic Action 1.

(Parts per million.)

Date.	Untreated Raw Sewage.			Same after 16 hours' Septic Action.			Same further treated by Aeration.			Same 16 hours later. Total of 32 hours' Septic Action.		
1911	Free Amm.	Alb. Amm.	Oxygen Con-sumed.	Free Amm.	Alb. Amm.	Oxygen Con-sumed.	Free Amm.	Alb. Amm.	Oxygen Con-sumed.	Free Amm.	Alb. Amm.	Oxygen Con-sumed.
June 2.....	17.25	10.75	73.3	19.0	4.25	32.9	19.00	3.25	38.	21	4.75	34
5.....	15.00	8.25	51	17.0	3.75	36.8	17.0	3.25	‡54	21	3.25	27.7
14.....	21.00	5.5	56.4	19.0	3.75	43.0	16.5	4.0	‡50.2	15.5	3.0	‡58.3
15.....	20.5	8.0	48.2	15.0	3.0	32.0	15.0	3.0	15.8	27.0	2.0	18.6
16.....	16.0	9.0	61.4	28.0	3.0	26.4	30.0	3.0	28.8	32.0	3.0	22.2
19.....	21.5	6.0	99.0	32.5	4.0	30.6	34.5	4.0	30.6	34.5	0.5	40.1
23.....	16.5	3.0	43	18.5	1.0	19.8	15.0	1.0	16.5	18.0	2.0	21.2
26.....	21.0	6.5	89	20.0	1.5	25.7	18.0	2.5	24.8	21.0	2.5	22.4
27.....	14.0	4.5	100	19.0	1.5	22.8	17.0	2.0	21.9	21.0	1.5	21.9
28.....	14.0	5.5	47.6	16.0	4.0	36.6	15.0	5.0	37.1	19.0	1.5	15.25
29.....	20.5	3.5	37.1	20.0	......	33.8	16.5	2.0	29.0	17.0	1.5	14.3
July 3.....	13.0	7.0	34.3	32.0	4.5	19.9	32.0	4.0	23.8	35.0	2.0	12.3
4.....	8.0	8.0	28.6	15.0	5.0	18.8	15.0	2.0	12.3	22.0	1.0	19.05
5.....	12.5	7.0	45.7	18.5	2.0	30.5	16.0	2.0	33.3	......	......	26.6
10.....	17.7	15.35	79.43	19.2	7.35	24.7	17.2	5.3	19.0	23.2	2.85	20.0
13.....	13.3	8.4	36.2	32.8	4.9	31	33.8	6.4	24.2	27.8	2.9	19.1
14.....	16.5	12.0	45.52	24.5	4.0	13.9	22	5.	19.0	28.0	3.0	31.4
19.....	19.5	23	92.7	......	......	......	......	......	......	......	......	......
20.....	13.0	25.5	45.4	36.0	4.0	47.8	41	5.	19.8	38.0	1.5	28.5
21.....	22	21	78.7	44.5	5.0	45	30.5	5.	43.9	40.5	3.0	29.5
24.....	20.5	7.0	57	22.5	5.0	50.2	22.5	3.0	29.9	30.5	3.5	21.3
25.....	16	9.0	95.6	20.0	4.0	42.5	28.5	4.0	38.6	28	3.5	25.1
26.....	22.5	12.0	72	40.5	2.0	54.2	33.5	5.0	45.4	43.5	2.0	25.1
27.....	21	12.0	68	33	4.5	38.6	33	3.5	39.6	47.	3.5	27.1
28.....	34	26	74.2	21	6.0	37.7	38.	6.0	22.3	38	5.0	32.8
Aug. 1.....	30	8.5	72.0	38	‡15.	73.4	35.	9.0	27.5	47	4.5	23.7
2.....	23	20	75.5	35	‡17.	58.9	18	8.0	28	32	4	27.1
3.....	20.5	18	76.4	33	9.0	34.8	31.	7.0	40.5	34	4	38.7
4.....	37.5	17	53.2	47.5	5.0	43.5	42.5	3.0	27.	45.5	3	25.
10.....	16.5	7	68	69.5	7.0	37.6	44.5	4.0	34.8	52.5	1.5	21.3
11.....	13.5	18	53.2	33.5	7.0	31.7	29.5	6.0	‡57.9	34.5	3	23.1
15.....	17.5	8	71.2	37.5	7.0	37.2	37.5	8.0	15.4	41.5	6	15.4
16.....	28.7	19.2	78.5	41.7	7.2	63.5	37.7	5.2	25	26.7	1.26	25
Sep. 15.....	29.2	12.5	67.7	35.7	3.0	29.2	20.7	2.5	29.2	35.24	3.5	19.3
16.....	20.2	12.5	66.4	19.24	5.5	38.6	15.2	3.5	41.6	25.24	3.5	32.85
10–12, 19	25.7	14.5	56	37.74	3.0	24.8	32.7	3.5	20.3	35.24	2.5	22.8
2–4, 19	37.74	28.5	99.2	38.74	1.5	25.4	36.74	1.5	20.8	37.74	1.0	20.3
10–12, 20	31.74	14.5	62.9	34.74	3.5	27.7	33.74	3.5	27.7	44.74	1.5	20.8
12–2, 20	25.74	20.5	69.4	33.74	1.5	31.8	27.74	1.5	30.8	35.7	2.0	35.7
2–4, 20	21.74	11.5	65.5	32.74	3.5	43.7	34.74	3.0	29.8	39.7	1.5	22.8
21.....	25	18	58.5	30	4.0	41.5	32	8.0	29.7	36.0	4.0	36.6
*21.....	24.5	16	58.5	30	4.0	39.6	33	7.0	31.7	38.0	4.0	34.6
†21.....	25	15	58	29	6.0	35.6	34	8.0	30.7	38.0	4.0	33.6
22.....	37	6	55.5	25	2.5	26.8	24.5	2.5	23.8	35.0	0.5	30.7
*22.....	36	6	46.5	24.5	2.5	31.7	25	2.5	21.8	35.0	0.5	29.7
†22.....	37.5	7	49.5	24.5	3.0	26.8	24.5	2.5	23.8	34.5	0.5	30.7

*Duplicate. †Triplicate. ‡Excluded from average.

TABLE I.—Continued.

Date. 1911	Untreated Raw Sewage. Free Amm.	Alb. Amm.	Oxygen Consumed.	Same after 16 hours' Septic Action. Free Amm.	Alb. Amm.	Oxygen Consumed.	Same further treated by Aeration. Free Amm.	Alb. Amm.	Oxygen Consumed.	Same 16 hours later. Total of 32 hours' Septic Action. Free Amm.	Alb. Amm.	Oxygen Consumed.
Sep. 23.....	22.26	8.5	59.5	44.26	2.5	32.7	38.76	4.0	29.7	32.7	3.0	26.8
*23.....	26.26	9.0	66.2	38.26	2.5	38.6	38.26	5.5	28.7	30.7	2.0	30.7
†23.....	......	......	55.5	40.26	2.5	36.6	40.26	5.5	28.7	28.76	3.0	28.7
25.....	20.76	9	50.5	40.76	4.0	33.7	34.76	4.0	21.8	37.7	2.5	11.9
*25.....	24.25	9	50.5	40.76	4.0	33.7	34.76	3.0	22.3	37.7	3.0	11.9
†25.....	24.76	11	50.5	42.76	4.0	33.7	34.76	3.0	24.3	37.7	3.0	11.9
Average...	22.1	11.9	62.5	30.6	4.0	35.7	28.7	4.2	27.5	32.9	2.6	25.0

*Duplicate. †Triplicate.

SUMMARY.

Stage.	Free Amm.	Alb. Amm.	Oxygen Consumed.
Untreated Sewage............	22.1	11.9	62.5
16 hour Septic	30.6	4.0	35.7
Aeration of Same.............	28.7	4.2	27.5
32 hour Septic	32.9	2.6	25.0

THE PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION OPERATING DATA.

TABLE II.

Chemical changes during Sewage Purification—Septic Action 2.

(Parts per million.)

Date.	Untreated Raw Sewage.			Same after 8 hours' Septic Action.			Same further treated by Aeration.			Same 8 hours later. Total of 16 hours' Septic Action.		
1911	Free Amm.	Alb. Amm.	Oxygen Con-sumed.	Free Amm.	Alb. Amm.	Oxygen Con-sumed.	Free Amm.	Alb. Amm.	Oxygen Con-sumed.	Free Amm.	Alb. Amm.	Oxygen Con-sumed.
June 2.....	17.25	10.75	73.3	10.5	6.00	33.9	11.5	5.2	32.	15	6.25	38
5.....	15.0	8.25	51.	15.5	5.75	34.	10.5	4.75	33.	15.5	3.25	32.9
14.....	21.00	5.5	56.4	21.0	6.00	64.5	27.5	6.25	60.6	21.5	1.50	36.3
15.....	20.5	8.0	48.2	17.0	4.00	28.7	17.5	4.0	28.2	16.0	3.0	29.8
16.....	16.0	9.0	61.4	21.0	6.00	28.8	20.0	6.0	30.7	21.5	5.0	21.7
19.....	21.5	6.0	99.0	30.5	1.0	16.1	28.5	3.0	87.2	34.5	4.0	66.5
23.....	16.5	3.0	43.0	17.5	2.0	18.4	12.5	2.0	23.6	15.5	1.5	19.3
26.....	21.0	6.5	89.0	17.0	2.5	34.7	17.0	2.5	30.0	22.0	6.5	34.7
27.....	14.0	4.5	100	21.0	5.5	48.0	17.0	3.5	29.5	21.0	3.5	39.5
28.....	14.0	5.5	47.6	15.5	.8.5	36.2	15.5	4.0	24.8	18.0	2.5	48.1
29.....	20.5	3.5	37.1	14.5	3.5	25.7	19.5	2.5	26.6	18.0	3.0	23.3
July 3.....	13.0	7.0	34.3	29.5	6.0	40.0	28.0	4.0	26.6	37.0	3.0	23.8
4.....	8.0	8.0	28.6	11.0	3.5	29.5	10.0	4.0	22.85	15.5	1.5	12.3
5.....	12.5	7.0	45.7	14.0	5.5	35.2	14.0	4.5	22.85	17.0	3.0	21.9
10.....	17.7	15.35	79.43	22.7	10.3	37.1	25.7	6.35	29.5	26.7	4.35	17.1
13.....	13.3	8.4	36.2	36.8	10.4	69.0	35.8	10.4	50.	33.8	3.24	52.4
14.....	16.5	12.0	45.52	24.5	10	49.5	24.5	7.0	33.3	24.5	1.0	28.8
19.....	19.5	23.	......	......	......	......	......	......	......	......	......	......
20.....	13.0	25.5	92.7	21.0	4.	28	20	2.5	27.5	27.0	4.0	34.
21.....	22.	21.	45.4	24.0	12.0	50.7	24.5	9.	31.4	33.5	3.5	14.9
24.....	20.5	7.0	78.7	22.5	5.0	32.8	23.5	4.5	27.5	31.5	3.0	34.8
25.....	16.0	9.0	57	20.5	6.0	46.4	20.5	5.0	35.7	22.0	3.0	26.1
26.....	22.5	12.0	72.	37.5	12.0	58.5	37.5	10.	53.2	41.5	4.0	26.6
27.....	21.0	12.0	68.	37.	8.0	36.7	19.	5.	35.7	47.0	4.0	23.7
28.....	34.0	26.	74.2	38.	7.0	24.1	33.	5.0	38.7	35.0	4.0	18.3
Aug. 1.....	30.0	8.5	72.0	37.	8.0	41.6	36	6.0	26.1	48.0	6.0	14.5
2.....	23.0	20.	75.5	24.	11.0	34.9	25	11.0	32.8	32.0	4.5	20.3
3.....	20.5	18.	76.4	25.5	6.0	31.9	27	6.0	44.5	34.0	6.0	36.7
4.....	37.5	17.	53.2	40.5	4.0	32.8	38.3	5.0	33.8	48.5	4.0	19.4
10.....	16.5	7.	68.	25.5	4.0	43.5	25.5	3.5	39.6	39.5	2.0	26.1
11.....	13.5	18.	53.2	20.5	7.0	24.0	20.5	6.0	22.1	41.5	3.0	16.3
15.....	17.5	8.0	71.2	41.5	6.	31.7	41.3	7.0	38.5	46.5	6.0	18.2
16.....	28.7	19.2	78.5	34.7	8.26	32.7	33.7	7.2	32.7	39.7	2.2	14.4
Average.....	19.2	11.5	62.8	24.7	6.4	36.8	23.7	5.4	34.7	29.4	3.6	27.8

SUMMARY.

Stage.	Free Amm.	Alb. Amm.	Oxygen Consumed.
Untreated Sewage............	19.2	11.5	62.8
8 hour Septic	24.7	6.4	36.8
Aeration	23.7	5.4	34.7
16 hour Septic	29.4	3.6	27.8

THE PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION OPERATING DATA.

TABLE III.

Chemical changes in the Purification of Sewage. Biologic Treatment (Parts per million.)

Date.	Raw sewage.			After treatment on Contact Bed A.			After treatment on Contact Bed B.			After treatment on Sprinkling filter.			After treatment on Intermittent Sand Bed.		
1912	Free Amm.	Alb. Amm.	Oxygen consu'd.	Free Amm.	Alb. Amm	Oxygen consu'd.	Free Amm.	Alb. Amm.	Oxygen consu'd.	Free Amm.	Alb. Amm.	Oxygen	Free Amm.	Alb. Amm.	Oxygen.
June 2	18.5	12.2	90.8	17.5	4.0	36.8	80.0	5.2	36.8	10.	2.75	31.	1.5	0.75	12.4
" 5	18.5	5.2	52.0	17.7	3.75	38	17.00	3.00	4.1	8.25	0.75	14.8	2.00	0.75	19.1
" 14	21.0	7.5	66.0	15.0	3.5	32.5	14.5	3.00	48.3	12.50	2.50	50.6	3.00	1.25	32.5
" 15	21.0	6.0	63.0	15.0	4.5	33.5	16.0	1.5	40.6	1.5	1.0	23.4	....	....	....
" 16	20.0	9.0	42.5	20.0	4.0	31.2	19.0	4.0	18.9	3.5	1.00	15.6	....	....	....
" 19	26.5	7.0	91.0	16.5	5.0	46.2	18.5	4.0	45.3	4.5	3.0	34.0	2.5	0.5	19.4
" 23	15.5	5.0	80.25	13.5	0.5	37.4	15.5	1.0	37.4	3.5	2.0	49.5	2.5	1.0	31.1
" 26	20.0	8.0	61.4	16.0	3.0	29.5	18.0	2.0	41.9	3.0	1.5	23.3	....	....	....
" 27	17.0	6.5	53.7	12.0	1.5	25.2	11.2	2.5	39.0	2.0	1.0	5.7	3.0	0.1	9.04
" 28	20.0	8.5	66.6	16.0	2.0	28.6	19.5	3.0	32.4	0.5	1.0	5.7	....	....	....
" 29	22.0	4.5	74.7	13.0	2.0	24.2	13.0	....	29.0	1.50	0.0	5.7	....	....	....
" 30	23.0	8.0	41.8	17.0	3.0	16.2	20.0	2.0	7.6	....	....	....	....	....	....
July 3	15.0	6.5	74.3	13.0	3.5	30.4	20.5	4.0	27.6	5.0	3.0	7.6	2.0	1.5	1.90
" 4	14.0	8.0	57.2	9.0	4.0	22.8	7.5	6.0	51.4	2.0	....	12.3	....	....	....
" 5	16.5	8.0	39.0	13.5	2.0	24.7	14.0	2.5	22.8	....	....	13.3	....	....	....
" 10	33.7	20.3	86.5	17.7	19.3	37.6	21.7	6.35	35.2	2.2	3.35	24.7	1.25	1.85	18.1
" 13	13.8	21.8	58.0	13.3	14.8	25.3	15.8	18.4	45.7	‡44.8	‡24.4	40.	2.65	2.45	23.2
" 14	16.5	6.0	37.6	14.5	3.5	30.0	21.0	2.0	35.7	5.5	1.2	45.	....	....	....
" 15	22.0	16.0	54.25	19.0	9.0	34.7	17.0	8.0	26.3	....	....	....	....	....	....
" 19	21.0	22.0	64.25	14.5	13.0	26.2	19.0	13.0	37.5	9.5	4.0	26.2	2.75	0.5	18.1
" 20	21.0	8.0	52.7	13.5	4.0	22.3	19.0	3.0	28.0	16.	3.0	9.17	....	....	....
" 21	35.5	19.0	63.7	19.5	14.0	30.9	18.5	13.0	51.25	18.5	6.0	11.1	....	....	....
" 22	30.5	15.0	34.8	18.5	3.5	17.9	22.5	4.0	23.2	....	....	....	3.0	1.5	4.8
" 24	24.5	8.0	40.6	19.5	6.0	31.9	21.5	5.0	42.0	7.5	3.5	10.6	....	....	....
" 25	32.5	16.0	78.2	21.5	10.0	42.5	18.5	9.0	31.9	4.0	0.2	16.4	2.5	1.5	9.17
" 26	32.5	36.0	70.1	27.5	31.0	53.2	25.5	20.0	50.2	29.7	6.5	27.1	....	....	....
" 27	35.	15.0	102.5	25.0	8.0	53.1	29.0	5.0	43.5	19.5	2.0	12.5	....	....	....
" 28	17.5	27.0	53.2	16.0	20.0	42.5	20.0	22.0	34.8	22.0	8.0	24.1	3.0	2.0	7.7
" 29	43.0	15.0	53.1	35.0	6.0	41.5	30.0	5.0	11.6	....	....	....	....	....	....
" 31	44.0	18.0	56.0	24.5	15.0	46.4	24.0	15.0	33.8	....	....	....	2.75	2.5	12.6

‡Omitted from average.

THE PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION OPERATING DATA.

TABLE III.—Continued.

Chemical changes in the Purification of Sewage. Biologic Treatment (Parts per million.)

Date.	Raw sewage.			After treatment on Contact Bed A.			After treatment on Contact Bed B.			After treatment on Sprinkling filter.			After treatment on Intermittent Sand Bed.		
1912	Free Amm.	Alb. Amm.	Oxygen consu'd	Free Amm.	Alb. Amm.	Oxygen consu'd	Free Amm.	Alb. Amm.	Oxygen consu'd	Free Amm.	Alb. Amm.	Oxygen.	Free Amm.	Alb. Amm.	Oxygen.
Aug. 1	57.0	21.0	74.5	23.0	10.0	40.6	27.0	11.0	37.7	11.0	2.0	12.6	....	....	....
" 2	27.0	25.0	73.5	39.0	12.0	33.8	23.0	21.0	38.6	13.0	4.5	14.5	....	....	....
" 3	37.0	16.0	61.8	28.0	13.0	38.7	27.0	13.0	37.7	0.5	4.0	15.5	0.75	0.5	11.6
" 4	24.5	18.0	50.25	20.0	13.0	33.8	18.5	13.0	35.7	....	....	11.6	....	....	....
" 5	28.5	21.0	68.25	23.0	11.0	49.2	24.5	11.7	41.5	....	....	....	....	....	....
" 9	15.5	15.0	107.	14.5	10.0	50.2	....	....	....	....	....	....	1.75	0.5	11.6
" 10	24.5	25.	87.	20.5	17.0	46.2	22.0	16.0	62.7	6.0	0.5	18.3	....	....	....
" 11	19.5	14.	57.2	18.8	7.0	38.0	18.5	10.0	35.6	8.5	5.0	13.4	....	....	....
" 12	28.5	23.	87.2	18.5	15.0	40.7	18.5	16.0	57.2	....	....	....	2.0	2.0	17.3
" 15	20.5	12.0	57.7	17.5	6.0	22.1	18.5	6.0	33.7	15.5	‡10.	20.2	1.5	1.0	2.89
" 16	17.6	21.2	60.5	22.2	17.2	42.2	28.7	12.2	42.2	10.7	3.26	16.3	....	....	....
" 17	49.7	33.2	82.7	20.7	16.2	38.4	36.7	15.2	55.7	....	....	....	....	....	....
" 18	19.26	12.2	54.7	19.2	4.2	25.9	23.7	0.79	47.0	....	....	....	0.76	‡11.0	9.6
" 19	36.7	12.2	54.7	24.7	6.2	32.7	28.7	11.2	46.2	....	....	....	....	....	....
" 21	20.7	9.2	61.5	15.2	4.2	33.9	19.2	7.2	48.1	7.2	1.2	17.3	2.2	0.26	13.4
" 22	20.5	10.5	61.0	17.5	8.5	35.0	20.5	5.5	37.9	23.5	5.5	28.8	....	....	....
Averages ...	24.7	14.3	64.3	18.8	8.5	34.7	21.8	8.2	37.1	8.7	2.5	20.2	2.2	1.2	14.5

SUMMARY.

Stage.	Free Amm.	Alb. Amm.	Oxyg. Con.
Raw Sewage	24.7	14.3	64.3
Contact Bed A	18.8	8.5	34.7
Contact Bed B	21.8	8.2	37.1
Sprinkler Filter	8.7	2.5	20.2
Intermittent Sand Filter	2.2	1.2	14.5

A—Coke. B—Broken Glass.
‡Omitted from average.

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TABLE IV.

Chemical changes—Sprinkling Filter—Sewage Purification.

(Parts per million,)

Date. 1912	Raw Sewage.			Same showing effect first 7 inches of media.					13 inches of media.					18 inches of media.					5 feet 6 inches of media.				
	Free ammonia.	Alb. ammonia.	Oxygen consumed.	Free ammonia.	Alb. ammonia.	Oxygen consumed.	Nitrites.	Nitrates.	Free ammonia.	Alb. ammonia.	Oxygen consumed.	Nitrites.	Nitrates.	Free ammonia.	Alb. ammonia.	Oxygen consumed.	Nitrites.	Nitrates.	Free Ammonia.	Alb. ammonia.	Oxygen consumed.	Nitrites.	Nitrates.
January 16	....	....	.....	....	....	60	.....	.....	....	....	60	....	.....	.....	....	26.3	....	.....	....	.....	30.9	.....	....
" 17	20.5	17.0	101.0	18.5	13.5	76	.....	.....	17	‡5.0	50	....	.....	10.5	6.0	43.0	....	.....	7.5	2.0	.....	.....	....
" 18	21.5	17.0	76.0	19.5	5.0	43.1	.....	.....	14	11.0	44	....	.....	7.5	....	45.0	....	.....	7.	4.5	33.	.....	....
" 19	17.5	16.0	73.5	18.5	9.0	62.5	.....	.....	17.5	5.0	40	....	.....	12.5	2.	34.9	....	.....	6.5	0	27.3	.....	....
" 20	33.5	14.0	87.0	32.5	8.0	51.5	.....	.....	26.5	6.5	39.2	....	.....	22.5	3.5	46.	....	.....	1.5	0	23.6	.....	....
" 22	19.0	15.0	84.3	18.5	9.5	68.7	.....	.....	19.0	7.5	44.9	....	.....	18.5	4.0	35.9	....	.....	10	2.0	28.4	.....	....
" 23	23.7	13.0	82.5	19.7	8.2	49.5	.....	.....	23.3	....	33.9	....	.....	20.7	3.3	37.6	....	.....	10.2	1.2	19.3	.....	....
" 24	27.8	18.0	87.0	25.8	14.0	73.5	.....	.....	27.8	12.0	59.5	....	.....	26.8‡	‡19.0	‡64.	....	....	‡24.8	4.5	28.2	.....	....
" 25	19.0	9.0	82.6	24.5	5.4	63.2	.....	.....	26.5	4.0	42.3	....	.....	27.5‡	3.0	37.4	....	....	‡18.5	1.0	39.4	.....	....
" 26	21.5	12.0	60.5	19.5	8.5	49.5	.....	.....	20.5	4.0	31.2	....	.....	19.5	4.0	31.2	....	.....	11.0	1.0	22.9	.....	....
May 16	22.0	7.0	53.6	21.0	9.0	39.1	.....	.....	18.0	7.0	54.6	....	.....	13.50	7.0	‡80	....	.....	8.0	1.5	20.9	.....	....
" 17	21.5	9.5	29.1	19.5	10.5	30.	.....	.....	18.5	‡9.5	55.4	....	.....	13.0	6.5	32.7	....	.....	9.5	5.5	15.45	.....	....
" 18	9.5	8.5	25.4	12.5	5.5	17.2	.....	.....	9.0	21.5	31.8	....	.....	7.5	‡18.5	24.55	....	.....	5.5	‡12.5	15.45	.....	....
" 21	20.0	8.0	45.5	20.0	7.0	32.7	.....	.....	17.0	2.0	29.1	....	.....	15.0	2.0	24.5	....	.....	9.0	3.0	10.9	.....	....
	Spray rested May 23 to June 3rd. Water then used instead of sewage to discover character of normal humus washing through.																						
June 3rd, 2 p.m. ‡	0.0	0.0	.....	2.0	20.5	200.	.....	.....	2.0	22.5	212.	....	.....	3.0	83.5	315.	....	.....	4.0	16.0	37.5	...	Not included in averages
" 3 p.m. ‡	"	"	.....	2.0	23.5	697.	.....	.....	2.0	82.5	366.	....	.....	9.5	300	467.0	....	.....	3.0	9.0	82.5		
" 4 p.m. ‡	"	"	.....	2.0	16.5	99.0	.....	.....	2.0	5.5	83.5	....	.....	1.0	10.5	53.2	....	.....	3.0	11.0	72.5		
" 5 ‡	"	"	.....	1.0	5.5	39.4	.....	.....	1.0	1.5	26.6	....	.....	1.0	2.5	23.8	....	.....	1.5	1.0	60.5		
" 6 ‡	"	"	.....	2.0	4.0	32.1	.....	.....	.5	1.5	31.2	....	.....	.5	4.0	33.9	....	.....	3.0	2.5	29.3		
" 7 ‡	"	"	.....	.50	3.5	41.2	.....	.....	.5	4.0	33.9	....	.....	.5	4.0	29.3	....	.....	1.0	4.0	16.5		
June 28	Sewage added again June 28th. Hourly observations commenced.																						
" 1st hour	21.5	11.0	41.0	21.5	60.0	30.5	trace	.15	7.5	3.0	27.6	1.7	0.5	4.5	3.0	20.9	7.8	.8	1.5	3.0	10.95	.87	.15
" 2nd hour	....	....	.....	19.5	6.0	36.2	.06	.1	17.5	6.0	45.7	14.7	0.6	7.0	3.0	18.1	0.2	1.0	2.5	3.0	11.4	3.0	1.2
" 3rd hour	....	....	.....	23.5	7.0	27.1	1.0	trace	17.5	5.0	42.8	.07	trace	11.5	2.5	41.9	2.4	trace	2.5	3.0	5.62	3.7	1.4
" 4th hour	....	....	.....	23.5	7.0	26.7	0.1	"	19.5	6.0	‡86.6	.1	"	17.5	2.5	‡59.1	2.2	.75	3.0	1.5	19.05	0.4	.5
" 5th hour	....	....	.....	20.5	5.0	59.1	0.1	0.5	18.5	7.0	51.4	.1	"	13.5	5.0	24.7	6.6	trace	5.5	5.0	13.3	.44	1.5
" 6th hour	....	....	.....	24.5	7.0	49.6	0.1	trace	23.5	7.0	‡63.8	.1	"	20.5	7.0	‡59.1	14.9	2.9	4.0	3.0	39.1‡	1.45	1.9

‡Excluded from the average.

THE PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION OPERATING DATA. TABLE IV.—Continued.

Date. 1912	Raw Sewage. Free ammonia.	Alb. ammonia.	Oxygen consumed.	Same showing effect first 7 inches of media. Free ammonia.	Alb. ammonia.	Oxygen consumed.	Nitrites.	Nitrates.	13 inches of media. Free ammonia.	Alb. ammonia.	Oxygen consumed.	Nitrites.	Nitrates.	18 inches of media. Free ammonia.	Alb. ammonia.	Oxygen consumed.	Nitrites.	Nitrates.	5 feet 6 inches of media. Free ammonia.	Alb. ammonia.	Oxygen consumed.	Nitrites.	Nitrates.
July 2	32.5	9.5	81.9	32.5	8.5	37.6	‡1.06	‡2.0	30.5	7.5	51.0	1.0	14.0	24.5	6.5	18.57	2.2	36.0	8.5	1.0	6.67	2.2	48.0
" 3	26.5	6.5	46.6	20.5	6.5	41.9	....	....	16.5	4.5	33.3	....	....	9.0	2.0	13.3	....	....	1.0	3.5	11.4	....	....
" 4	24.5	22.5	33.3	18.5	4.5	26.7	....	....	13.5	3.5	23.8	....	....	7.5	1.5	14.3	....	....	1.0	2.0	7.62	....	....
" 5	34.5	7.0	27.6	29.5	13.0	37.0	....	....	25.5	10.0	47.1	....	....	17.5	5.0	19.5	....	....	9.5	5.0	7.13	....	....
" 8	20.5	9.0	30.0	22.5	12.0	46.6	....	....	13.0	12.0	20.95	....	....	9.5	4.0	31.4	....	....	3.0	4.0	5.75	....	....
" 9	28.5	6.5	28.5	22.5	8.5	40.	....	....	15.5	3.0	19.4	....	....	9.5	2.5	9.52	....	....	3.25	0.75	4.28	....	....
" 10	22.5	8.5	31.4	22.5	8.5	40.95	....	....	16.5	5.5	20.0	....	....	13.5	4.5	12.57	....	....	4.25	1.25	5.24	....	....
" 11	32.5	8.2	25.7	21.5	7.25	81.0	....	....	1.5	0.75	40.0	....	....	0.5	0.75	31.4	....	....	0.0	1.25	7.14	....	....
" 17	21.5	7.2	43.8	20.0	5.0	41.9	....	....	17.	2.0	25.7	....	....	6.0	2.0	25.7	....	....	4.0	0.5	9.05	....	....
" 18	20.5	6.25	37.2	22.5	9.25	42.4	....	....	17.5	6.25	24.35	....	....	17.5	5.25	14.35	....	....	7.75	2.62	9.8	....	....
" 22	21.5	4.0	30.1	20.5	12.0	46.6	....	....	13.5	9.5	39.8	....	....	10.0	6.0	21.35	....	....	3.25	2.0	7.28	....	....
" 23	27.0	6.0	30.1	22.0	10.0	41.7	....	....	13.0	5.0	27.0	....	....	7.5	4.0	19.9	....	....	3.75	2.0	8.75	....	....
" 24	20.0	5.0	28.3	22.0	6.0	31.1	....	....	13.0	5.0	10.67	....	....	10.0	4.0	8.74	....	....	2.75	1.75	5.83	....	....
July 25, 1914	22.0	7.0	36.9	22.0	8.0	35.0	....	....	16.0	6.0	17.5	....	....	11.5	3.5	18.9	....	....	8.0	1.50	5.1	....	....
Aug. 7	20.5	7.5	44.6	20.5	4.5	26.2	0.7	0.5	16.5	4.5	11.15	0.35	1.7	11.5	2.5	17.9	0.6	5.5	9.75	0.75	6.3	1.3	5.5
" 12	19.0	1.5	24.3	15.0	1.5	20.4	1.0	0.3	10.0	1.5	17.0	0.65	5.8	5.5	2.5	13.6	0.6	3.8	6.5	1.0	4.8	0.5	4.5
" 13	18.0	7.5	44.7	18.0	2.5	35.0	0.2	0.2	12.0	2.0	13.6	1.4	4.1	8.0	1.0	9.7	1.5	5.3	7.5	0.5	6.3	1.55	6.2
" 14	29.0	6.5	40.8	25.0	6.5	31.6	0.3	1.3	19.0	4.5	10.7	0.65	3.3	19.0	2.5	21.9	0.05	....	11.0	0.75	4.86	1.55	3.8
Sep. 10	21.5	7.5	58.3	16.5	10.0	75.6	0.8	5.0	16.5	7.0	44.7	2.5	3.0	17.5	6.0	38.9	3.2	0.3	6.75	2.0	‡14.55	1.0	15.0
" 11	22.5	3.0	35.0	21.5	5.0	52.3	0.7	trace	16.5	9.0	‡62.2	0.7	0.5	16.5	6.0	50.5	1.6	2.0	7.25	1.0	9.22	1.3	10.0
" 12	22.0	13.5	28.2	17.5	4.5	24.3	0.2	0.0	19.5	5.5	‡57.2	0.05	....	19.5	6.5	48.5	0.9	0.5	7.75	1.25	‡24.75	0.7	1.0
" 13	21.5	18.5	104.7	15.5	4.5	28.1	0.0	0.0	13.5	5.5	19.6	....	....	13.5	4.5	29.4	2.5	....	5.75	1.5	3.43	1.5	7.0
" 17	30.5	12.0	56.8	18.5	5.5	61.8	0.00	0.0	18.5	8.0	34.3	....	....	19.5	5.5	54.0	....	....	8.75	3.0	7.8	1.75	8.9
" 18	19.0	5.5	39.5	18.5	4.0	44.6	....	....	18.5	4.0	26.0	....	....	18.5	4.0	18.1	....	....	12.5	1.5	11.5	....	....
" 19	20.5	7.0	55.0	18.5	1.5	29.4	....	....	18.5	1.5	23.5	....	....	18.5	1.25	18.6	....	....	10.25	1.0	9.3	....	....
Averages	23.0	9.7	50.6	21.0	8.5	43.7	0.4	0.8	17.3	5.4	33.8	1.7	2.6	13.2	3.8	27.0	3.1	4.5	6.1	2.0	13.2	1.4	7.3

SUMMARY.

Stage.	Free Ammonia.	Alb. Ammonia.	Oxygen consumed.	Nitrites.	Nitrates.
Raw Sewage	23.0	9.7	50.6	....	....
7 inches of media	21.0	8.5	43.7	0.4	0.8
13 " "	17.3	5.4	33.8	1.7	2.6
18 " "	13.2	3.8	27.0	3.1	4.5
5 feet 6 inches of media	6.1	2.0	13.2	1.4	7.3

‡ Excluded from average.

THE PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION OPERATING DATA.

TABLE V.—1.

Chemical change due to filtration only—Sewage purification.

(Parts per million.)

Date.	Imhoff Effluent.						Imhoff Sludge Chamber.					
	Uufiltered.			Filtered.			Unfiltered.			Filtered.		
1911	Free Amm.	Alb. Amm.	Oxygen Consumed.	Free Amm.	Alb. Amm.	Oxygen Consumed.	Free Amm.	Alb. Amm.	Oxygen Consumed.	Free Amm.	Alb. Amm.	Oxygen Consumed.
May 31.....	21.0	17.0	18.1	21.5	2.5	11.8	20.5	5.5	30.9	20.5	0.5	12.7
June 1.....	20.5	9.0	100.	20.5	3.0	17.3	20.5	7.0	23.7	20.5	3.0	11.8
3.....	22.5	12.0	67.	22.5	4.0	21.7	22.5	5.0	30.8	22.5	3.0	17.8
5.....	30.5	43.5	174.	31.5	1.0	21.1	32.5	4.5	56.9	‡95.5	1.0	23.8
6.....	26.0	12.0	89.5	26.0	1.5	23.8	25.0	3.5	34.8	26.0	1.0	22.9
7.....	40.0	11.0	93.6	36.0	4.0	25.7	33.0	4.0	50.5	......	......	17.4
13.....	42.0	5.0	44.5	24.0	4.0	10.5	31.0	6.0	77.0	22.0	5.0	18.3
14.....	17.5	13.5	57.8	17.5	7.5	14.7	21.5	19.5	69.6	19.5	8.5	20.2
19.....	25.5	10.5	64.7	21.5	2.5	4.5	25.5	8.5	32.2	22.5	2.5	6.8
20.....	21.5	11.5	86.7	21.5	0	5.0	21.5	3.5	25.7	21.5	0	6.4
21.....	32.7	11.75	42.2	32.7	.75	8.2	26.7	2.75	22.9	25.7	.25	8.2
22.....	46.7	64.7	192.5	40.7	.25	11.0	37.7	6.75	32.1	32.7	1.25	7.3
24.....	33.7	8.7	241.	33.7	1.75	10.09	36.7	6.75	28.4	36.7	.75	6.4
25.....	36.5	2.0	72.4	35.5	0	16.5	36.5	5.0	42.2	36.5	1.0	30.2
26.....	25.5	9.0	75.2	22.5	1.0	21.1	22.5	11.0	27.5	19.5	1.0	22.9
27.....	25.5	9.0	46.7	25.5	1.0	14.3	26.5	10.0	47.6	38.5	6.0	16.2
28.....	21.5	11.0	41.0	21.5	3.0	15.2	25.5	15.0	71.5	25.5	5.0	29.5
July 2.....	32.5	9.5	81.9	30.5	3.5	18.1	36.5	15.5	85.7	36.5	5.0	13.3
3.....	26.5	6.5	46.6	25.5	3.0	15.2	28.5	8.5	41.9	......	3.0	12.4
4.....	24.5	22.5	33.3	24.5	1.0	15.2	20.5	11.5	44.8	20.5	2.5	15.2
5.....	34.5	7.0	27.6	33.5	4.0	16.1	22.5	13.0	52.4	22.5	4.0	19.5
8.....	20.5	9.0	30.0	20.5	7.0	16.2	32.5	46.0	228.5	32.5	4.0	16.2
9.....	28.5	6.5	28.5	28.5	3.5	13.3	32.5	21.5	97.2	32.5	3.5	7.6
10.....	22.5	8.5	31.4	22.5	2.5	12.3	32.5	8.5	47.6	32.5	3.0	12.37
11.....	32.5	8.2	25.7	32.5	5.2	16.2	32.5	21.2	89.6	32.5	8.2	10.47
17.....	21.5	7.2	43.8	21.5	2.7	17.1	26.5	16.2	100.	26.5	3.2	13.32
18.....	20.5	6.2	37.2	20.5	2.7	20.5	25.5	15.2	70.3	12.5	2.7	14.3
22.....	21.5	4.0	30.1	21.5	1.0	15.5	21.5	14.0	93.1	21.5	1.0	11.65
23.....	27.0	6.0	30.1	27.0	4.0	14.5	32.0	25.0	19.9	32.0	4.0	14.1
24.....	20.0	5.0	28.3	16.0	2.5	11.6	38.0	13.0	94.2	38.0	2.0	13.6
25.....	22.0	7.0	36.9	22.0	3.5	13.6	38.5	15.0	81.6	38.0	2.5	18.4
29.....	22.5	5.5	85.4	......	......	......	32.5	7.0	69.0	......	......	......
Average....	27.1	11.8	65.7	25.8	2.7	15.1	28.7	11.7	60.0	27.4	2.9	15.2

‡Excluded from average.

SUMMARY.

Stage.	Free Amm.	Alb. Amm.	Oxygen Consumed.
Imhoff Effluent, unfiltered	27.1	11.8	65.7
" filtered	25.8	2.7	15.1
Imhoff Side, unfiltered........	28.7	11.7	60.0
" filtered	27.4	2.9	15.2

THE PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION OPERATING DATA.

TABLE V.—2.

Chemical change due to filtration only, that is, removal of suspended matter—Sewage purification.

Date.	Raw Sewage.					
	Raw.			Filtered.		
1912	Free Amm.	Alb. Amm.	Oxygen Consumed.	Free Amm.	Alb. Amm.	Oxygen Consumed.
June 14..	26.5	20.5	59.6	11.0	5.5	29.4
July 5..	20.0	9.0	60.9	29.5	4.0	16.1
8..	20.5	16.0	88.6	20.5	8.0	28.1
9..	17.5	8.5	62.9	17.5	3.5	13.3
10..	16.5	15.5	53.3	16.5	6.5	20.0
11..	18.5	18.25	93.8	18.5	*15.2	*42.4
17..	18.5	17.25	81.9	17.5	5.25	24.7
18..	20.5	24.25	81.0	20.5	5.25	31.5
22..	17.5	11.0	78.3	17.5	2.0	22.3
23..	16.0	13.0	87.4	16.0	5.0	25.3
24..	20.0	10.0	77.6	20.0	5.0	31.1
25..	22.0	15.0	60.2	22.0	7.0	23.3

*Omitted from averages.

Date.	Sprinkler Washings. 7-in. media.									
	Unfiltered.					Filtered.				
1912	Free Amm.	Alb. Amm.	Oxygen Consumed.	Nitrites.	Nitrates.	Free Amm.	Alb. Amm.	Oxygen Consumed.	Nitrites.	Nitrates.
June 3..	2.0	20.5	200.	....	....	1.65	.15	....	....	....
3 p.m.	2.0	23.5	697.	....	....	.95	.15	2.93	....	....
4 p.m.	2.0	16.5	99.0	....	....	1.35	1.75	8.98	....	....
June 5..	1.0	5.5	39.4	....	....	.20	0	2.66	....	....
6..	2.0	4.0	32.1	....	....	.20	.10	4.04	....	....
7..	.5	3.5	41.2	....	....	....	....	3.67	....	....
12..	....	....	....	....	....	....	....	....	.04	.26
13..	....	....	....	....	....	....	....	....	.025	.11

Date.	Sprinkler Washings. 13-in. media.									
	Unfiltered.					Filtered.				
1912	Free Amm.	Alb. Amm.	Oxygen Consumed.	Nitrites.	Nitrates.	Free Amm.	Alb. Amm.	Oxygen Consumed.	Nitrites.	Nitrates.
June 3..	2.0	22.5	212.	....	....	.20	.15	6.05	....	....
3 p.m.	2.0	82.5	366.	....	....	.30	.25	3.85	....	....
4 p.m.	2.0	5.5	83.5	....	....	.55	1.25	7.98	....	....
June 5..	1.0	1.5	26.6	....	....	.20	.10	2.47	....	....
6..	.5	1.5	31.2	....	....	.20	.10	2.29	....	....
7..	.5	4.0	33.9	....	....	....	....	2.66	....	....
12..	....	....	....	....	....	....	....	....	.015	.65
13..	....	....	....	....	....	....	....	....	.01	.54

SUMMARY.

Samples.	Free Amm.	Alb. Amm.	Oxygen Consumed.
Raw Sewage, unfiltered.....	19.5	14.85	73.7
" filtered.......	18.9	5.18	24.1

TABLE V.—3.

Chemical Constituents. Filtered and Unfiltered Sewages—Dissolved Organic Matter.

Date.	Sprinkler Washings. 18-in. media. Unfiltered.					Sprinkler Washings. 18-in. media. Filtered.					Sprinkler Washings. 5 ft. 6 in. media. Unfiltered.					Sprinkler Washings. 5 ft. 6 in. media. Filtered.				
1912	Free Amm.	Alb. Amm.	Oxygen.	Nitrite.	Nitrate.	Free. Amm.	Alb. Amm.	Oxygen.	Nitrite.	Nitrate.	Free Amm.	Alb. Amm.	Oxygen.	Nitrite.	Nitrate.	Free Amm.	Alb. Amm.	Oxygen.	Nitrite.	Nitrate.
June 3 2 p.m.	3.0	83.5	315.	....	....	.20	.25	7.4	....	....	4.0	16.0	37.5	....	....	1.5	1.0	9.17	....	....
3 p.m.	9.5	300.	467.	....	....	3.9	16.0	51.0	....	....	3.0	9.0	82.5	....	....	.45	.25	7.0	....	....
4 p.m.	1.0	10.5	53.2	....	....	.4	.95	7.9	....	....	3.0	11.0	72.5	....	....	.45	.85	8.1	....	....
June 5	1.0	2.5	23.8	....	....	.45	.10	4.3	....	....	1.5	1.0	60.5	....	....	.55	.10	2.5	....	....
6	.5	4.0	33.9	....	....	.20	.10	2.2	....	....	3.0	2.5	29.3	....	....	.25	.15	3.6	....	....
7	.5	4.0	29.3	....	....	....	....	5.3	....	....	1.0	4.0	16.5	....	....	....	....	2.2	....	....
12	....	....	....	....	....	....	....	....	.005	.52	....	....	....	....	....	....	....	....	.02	.94
13	....	....	....	....	....	....	....	....	.006	.35	....	....	....	....	....	.70	.075	1.92	.005	.85

Date.	Sprinkler Effluent—Normal Operation. Unfiltered.					Sprinkler Effluent—Normal Operation. Filtered.				
1912	Free Amm.	Alb. Amm.	Oxygen.	Nitrite.	Nitrate.	Free Amm.	Alb. Amm.	Oxygen.	Nitrite.	Nitrate.
Sep. 10	6.75	2.0	14.5	1.0	15.0	5.75	3.0	7.29	0.5	15.0
Sep. 11 10-1	7.25	1.0	9.2	1.3	10.0	7.75	0.5	5.85	1.3	5.0
1-5	8.75	1.5	8.2	0.7	0.5	17.5	1.5	8.2	0.7	0.5
Sep. 12 10-1	7.75	1.25	24.7	0.7	1.0	7.75	1.25	7.2	0.7	1.0
1-5	14.5	1.5	6.3	0.2	2.8	14.5	0.75	8.2	0.25	2.8
Sep. 13	5.75	1.5	3.4	1.5	7.0	5.75	1.25	9.8	1.5	7.0
17	8.75	3.0	7.8	1.75	8.9	8.25	0.5	4.9	1.75	8.7
18	12.5	1.5	11.5	....	....	12.5	0.5	7.3	....	....
19	10.2	1.0	9.3	....	....	10.2	0.5	6.1	....	....
Av'ge	9.13	1.58	10.5	0.71	6.45	9.99	1.08	7.2	0.95	5.71

SUMMARY.

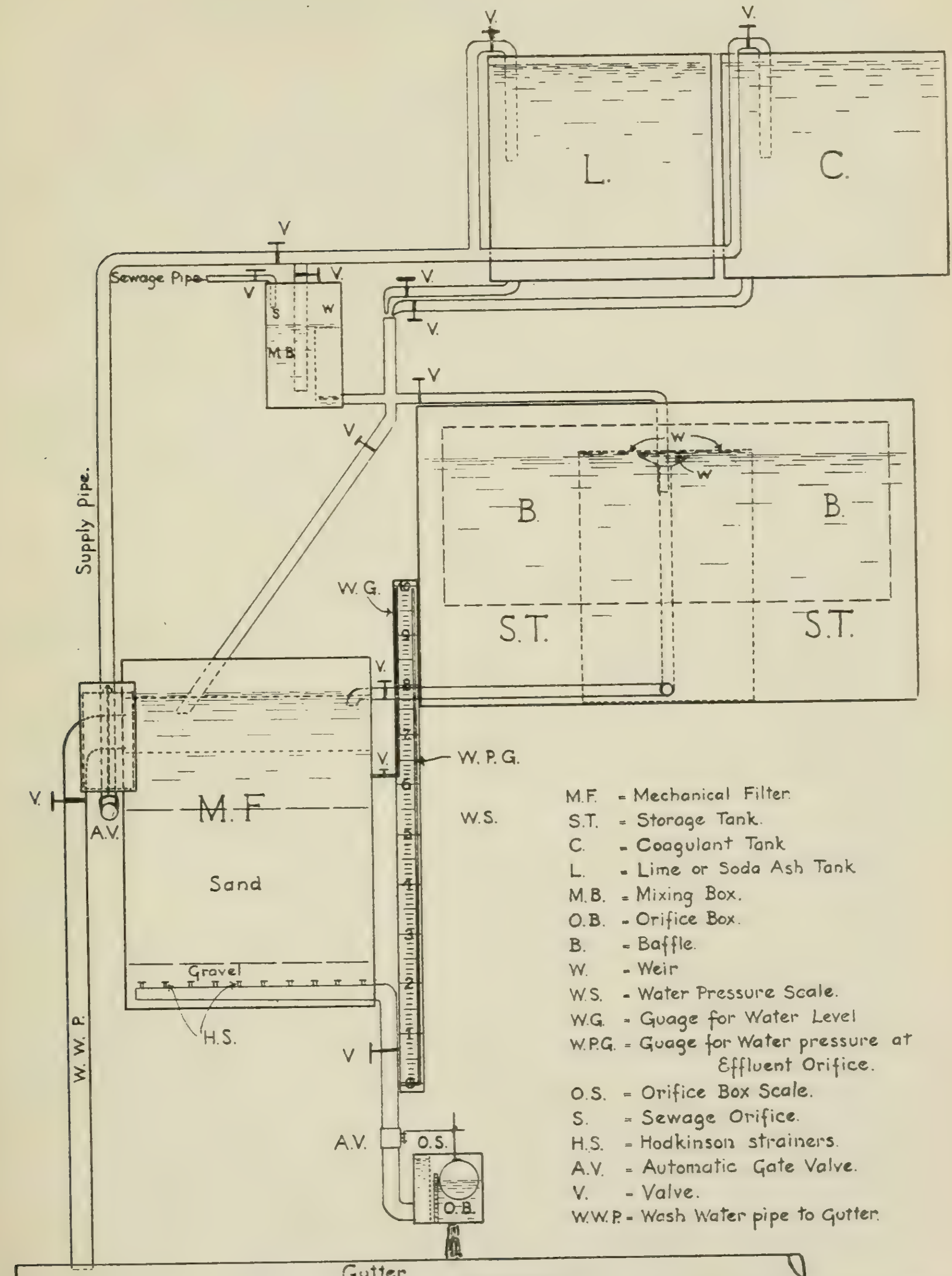
Samples.	Free Ammonia.	Alb. Ammonia.	Oxygen Consumed.	Nitrites.	Nitrates.
Sprinkler Effluent, Unfiltered	9.13	1.58	10.5	0.71	6.45
" " Filtered.	9.99	1.08	7.2	0.95	5.71

THE PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION OPERATING DATA.

Chemical Composition of Humus in the effluent of Sewage Disposal Beds—water was applied instead of sewage.

(Parts per Million.)

Time in minutes after starting operations.	Contact Bed—Glass Media. June 25th, 1912.					Contact Bed—Coke Media. June 25th, 1912.					Intermittent Sand Filter. June 20th, 1912.					Intermittent Sand Filter. June 24th, 1912.				
	Free Amm.	Alb. Amm.	Oxygen Consumed.	Nitrites.	Nitrates.	Free Amm.	Alb. Amm.	Oxygen Consumed.	Nitrites.	Nitrates.	Free Amm.	Alb. Amm.	Oxygen Consumed.	Nitrites.	Nitrates.	Free Amm.	Alb. Amm.	Oxygen Consumed.	Nitrites.	Nitrates.
0	2.17	.67	6.05	.08	22.4	.37	.175	3.76	.07	0.6	2.30	.25	3.86	.06	2.2	.47	.07	2.02	trace.	12.0
5	......	......	......	.03	18.8	......	......	......	.01	0.8	......	......	......	......	......	......	......	......	......	......
10	1.07	.37	4.5	trace.	14.0	.125	.23	3.48	.02	7.5	......	......	......	0.11	12.2	......	......	......	trace.	16.8
15	......	......	......	.015	12.8	......	......	......	trace.	8.7	......	......	......	......	......	......	......	......	......	......
20	.85	0	3.85	.02	14.0	.27	.27	.55	.005	7.6	......	......	......	0.10	11.56	......	......	......	.005	25.6
25	......	......	......	.015	10.4	......	......	......	.01	9.0	......	......	......	......	......	......	......	......	......	......
30	.75	0	3.16	.02	10.0	.27	.07	1.92	trace.	10.0	2.55	.55	7.52	.08	11.28	.37	.27	2.5	.012	21.6
35	......	......	......	.03	9.0	......	......	......	"	10.0	......	......	......	......	......	......	......	......	......	......
40	.95	0	2.11	.03	10.0	.37	.20	4.03	"	10.0	......	......	......	.16	11.08	......	......	......	.03	18.0
45	......	......	......	.025	13.6	......	......	......	"	10.0	......	......	......	......	......	......	......	......	......	......
50	.65	......	2.93	.02	14.8	.30	.75	1.92	"	10.0	......	......	......	.14	11.08	......	......	......	.05	16.0
55	......	......	......	.005	14.8	......	......	......	"	10.0	......	......	......	......	......	......	......	......	......	......
60	.85	.10	3.0	trace.	16.0	.125	.27	13.8	"	10.0	2.7	.50	7.16	0.14	10.8	.77	.37	3.4	.05	12.0
70	......	......	......	......	......	......	......	......	......	......	......	......	......	.13	10.36	......	......	......	.06	9.2
80	......	......	......	......	......	......	......	......	......	......	......	......	......	.13	10.36	......	......	......	.09	10.8
90	......	......	......	......	......	......	......	......	......	......	2.1	.7	9.36	0.10	......	.77	3.7	2.6	.05	8.6
Final Drippings..	21.6	2.67	18.6	0.1	28.0	5.07	1.67	9.5	0.1	6.0	......	......	......	......	......	......	......	......	.14	8.4



General Arrangement of the Gravity Mechanical Filter. (Experimental Station, 1913.)

STUDIES OF THE BEHAVIOUR OF MECHANICAL FILTERS, INCLUDING ANALYTICAL DATA.

C. S. Robertson, B.A.Sc.

Description of Apparatus.

The Mechanical Gravity Filter used in these experiments consisted of a circular tank made of two inch cypress, 7 feet deep by 5 feet in diameter. The surface area of the filter was 0.00045 of an acre. The filtering media consisted of 3 feet of sand which on analysis showed "Eff. size .39 MM., Unit Coeff. 1.6, in which the percentage voids was determined as equal to 40.7 per cent. of the total volume, and the filtration openings as equal to 21.6 per cent. of the total volume of 53.03 per cent. of the total voids."* This was supported by 8 inches of *bean* gravel, and separating the sand and the gravel was a heavy copper gauze screen. On June 1st this screen was removed as it was thought to be the cause of the increase in the loss of head, which began to show abnormal variation at that time. The bottom of the tank was provided with the usual wash water and air distributors used for cleaning the filter. (The apparatus being supplied by The American Water Softener Co.)

The capacity of the filter was 36,000 gallons per 24 hours when operating at the rate of 80 million gallons per acre per day.

A large float valve attached to the side of the tank regulated the inflow to the filter. The float was so set that when the water in the filter dropped below a certain level, the supply valve opened, and as the water rose the valve closed.

Passing the float valve the influent entered into a "mixing box" where a fine jet of sewage could be added and mixed with the inflowing water. This sewage was cut off when desired. From the mixing box the raw water was carried to a storage tank, before entering which chemicals could be added in doses as desired, and after being held for two hours, the raw water weired into the filter proper. For the first month the raw water was delivered by a 2½ inch pipe to the bottom of the storage tank at the side opposite the outlet, no precaution being taken to prevent agitation and eddying in the storaged water, the experiment being to show if possible the effect of these undesirable features in a storage reservoir upon filter efficiency. On May 4th the following improvements were installed which corrected the above condition. The outlet pipe, instead of discharging at the bottom of the storage tank, was extended but ten inches below the surface of the water. The water was then made to flow over a weir 3 ft. 6 in. long. By means of a baffle 9 feet long and 2 feet from the bottom of the tank the rate of flow was decreased to 0.04 inches per second, and a downward velocity was promoted realizing the desired conditions for good sedimentation.

The addition of the coagulant and the lime or soda ash was attained by dissolving the chemicals separately in two similar elevated tanks equipped with orifices. These tanks held 24 hours' supply (400 U.S. gallons) and discharged the chemicals into the raw water as it flowed from the mixing box to the storage tank.

The effluent control consisted of a rectangular box made of galvanized iron with a rectangular orifice opening in the bottom. This opening could be made larger or smaller by turning a rotating screw backward or forward. An indicator denoted the width in inches which the sliding orifice had been opened.

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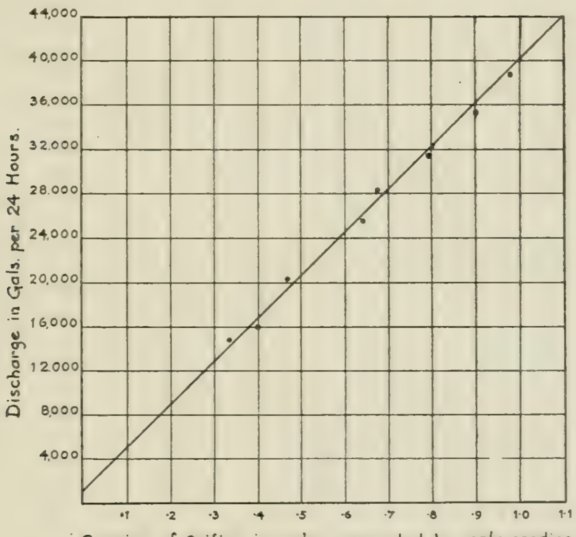
*Analysis, F. A. Dallyn, 1912. Annual Report Provincial Board of Health.

The flow to this orifice box was regulated by a 3½ inch float-valve which was set so as to maintain a constant 10 inch head; the maintenance of head was necessary owing to the fact that the opening in the orifice box had been calibrated for a 10 inch head.

A "loss of head" float was connected to the outlet pipe of the filter during the first experiment, by means of which the loss of head could be read direct. Unfortunately, due to friction, it was often slow in adjusting itself especially in starting the filter. To overcome this two water-glass gauges were erected alongside of a scale graduated in feet and inches. One glass gave the height of water in the filter, and the other gave the water pressure at the outlet valve of the filter, the difference between the readings giving the loss of head.

In experimenting with the Mechanical Gravity Filter the order of investigation was as follows:—

CALIBRATION OF ORIFICE BOX.
FOR
10 INCH HEAD.



1.—Comparison of its efficiency with that of the slow sand filter.

2.—Operation of the unit without a coagulant but running at a rate of 80,000,000 gallons per acre per day.

3.—The unit using a coagulant (Stock alum solution *not stirred*).

4.—The unit using a coagulant Stock alum solution *stirred*).

5.—The unit using alum and lime or soda ash (stirring of solution discontinued).

6.—The unit when *filtered water*, alum and soda ash were added direct to filter for 5 minutes before *polluted water* with coagulant was added.

7.—The unit when *filtered water* and alum were added direct to filter for 5 minutes before *polluted water* with coagulant was added.

This investigation does not deal with the question of filtering at different rates, different periods of storage, or the effect of turbidity on the filter. The research is confined to observations when filtering 80,000,000 gallons per acre per day with a two hours' storage after the use of chemicals.

Technique.

In studying the behaviour of the filter the raw and filtered water were subject to the same technique of examination and incubation in order to give strictly comparative results. Unless otherwise stated, all samples of raw water were collected just as the water was being admitted to the filter proper, after having received the necessary chemicals and after having been subjected to the usual two hours' storage. Thus the results record the bacterial efficiency of the filter proper without taking into consideration any efficiency derived from sedimentation in the storage tank. Two plates were inoculated from each sample, one being incubated at 37 degrees C. for 24 hours, and the other at 18-22 degrees C. for 48 hours. The fermentation tests for Colon bacilli were read after an incubation of 48 hours at 37 degrees C.

The Operation of the Mechanical Filter.

It appears from these experiments that without scientific management good results cannot be obtained, and too much cannot be said to impress upon those in charge the importance of proper care when handling polluted raw water. It is the experience of the writer that carelessness in the slightest detail or ignorance in operating the filter brings about disastrous results. A filter that is poorly operated is perhaps more dangerous than the use of a known polluted water supply. In the latter case, people are aware of the danger and can safeguard themselves, but with the former, the water emitted from the filter may at any time be suddenly infected, and unconscious of the fact citizens fall victims of water-borne diseases.

To derive the best results every filtration plant should have in connection with it a laboratory equipped to perform physical, chemical, and bacteriological examinations, and all under the direction of skilled management. Records of both raw and filtered water regarding color, turbidity, tastes, alkalinity and bacteria counts; data relating to the length of run, wash water, amount of coagulant and other chemicals used; and facts relating to any unusual behaviour of the filters, are of valuable assistance to the superintendent and are used for anticipating the adjustment of the filters to meet unusual conditions.

The following is a summary of the type of observations made on the experimental mechanical filter herein reported upon:

1—Method of cleaning.
2—The filtering material.
3—How long to waste water after cleaning.
4—Loss-in-head that cannot be regained by washing.
5—Effect of varying head on the filter.
6—Adding coagulant.
7—Starting filter without washing.

(1) *Method of Cleaning*:

One of the most important if not the most important factor in the management of a filter, from an economic stand-point is the method of cleaning. To begin with, it is quite evident that to *clean* a filter, filtered water must be used. It was our practice in cleaning to use the water from the city mains, which was filtered water coming from the city's filtration plant at the Island.

The aim of the operator of a plant is to effect the cleaning of a filter, using as little "time," and "wash-water" as possible. This is quite apparent from the fact, that the greater the percentage of the run lost while cleaning a filter, the

larger the filtering area must be in the initial installation. Again, as the time for cleaning increases so also does the amount of wash-water used increase, causing a further additional increase in the filter area required. Thus the filtering area of a plant depends not only on the quantity of water to be consumed by the populace, but also on the "wash-water" used in cleaning. Under normal conditions the writer found that between 10 and 12 minutes were necessary for an effective cleaning, back-washing at a rate ranging from 20 inches to 24 inches per minute.

Another item of cost that enters into the above operation was the power required to generate compressed air for agitating the sand. As this, however, is somewhat outside this present paper I shall no more than mention it.

It is conclusive that the time employed for an effective cleaning must be reduced as low as possible. In my experiments this was best achieved by first sending in a reverse flow of filtered water which gave a rise in the filter of about one foot per minute. This will lift the flocculent filament that rests on the top of the sand and with it the greater percentage of dirt and contamination to be washed from the filter. Too great a flow at the beginning tends to break up the filament and necessitates a longer time to free the filter of this flocculent matter. When the filament has lifted, the flow is increased to give a rise of 20 to 24 inches per minute. After this, air and water are now used jointly, the air being administered for only 1 to 1½ minutes. The exception to this is when the filter has had a long run and the sand has become more compact, or when it has been receiving heavily polluted water with a large quantity of coagulant. Then air alone is used for a period of from 2 to 3 minutes to agitate the sand vigorously followed by the usual method of air and water jointly. When the filter is in exceptionally bad condition this agitation may have to be repeated, together with the removal of several inches of fine sand at the surface. The air seems to be instrumental in freeing the coagulant from the sand, while the reverse flow of water carries it to the surface and thence to the gutter. For the last 2 to 2½ minutes of the cleaning it is found important to decrease the flow down to 10 inches rise per minute. The explanation for this is that if following the cleaning, when the sand is agitated and partly in suspension, the up-flow is suddenly cut off and the outflow valve opened, putting the filter into action again, the sand comes down with a "bang" compacting itself very closely, with the result that the loss in head will rapidly increase resulting in a short run A period of settling for 3 minutes was tried following the agitation before the filter was put into action, but with only unsatisfactory results.

Great care should be taken in keeping the filtering media covered with at least 3 or 4 inches of water while the filter is working, otherwise, if it is allowed to settle below the surface of the sand it not only breaks the filtering filament, but also carries with it much of the coagulant and contamination down into the lower part of the bed. This is objectionable as it takes much longer to clean, and the efficiency of the filter for a time is impaired.

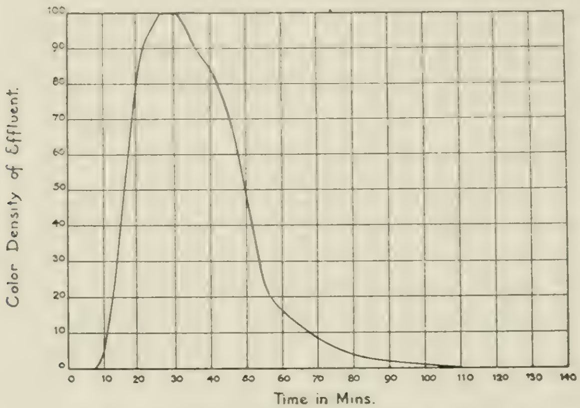
(2) *The Filtering Material*:

In choosing a filtering material one should obtain a sand the grains of which are as nearly uniform in size as possible; one must expect some of the finer grains to be carried away in the wash-water. It is necessary to see that as little as possible of the filtering material escapes; the level of the wash-water gutters can be designed to control this.

The time elapsing between the emitting of the water to the top of the filter and its escape from the effluent was obtained by adding a constant strength of Fluores-

cein to the water as it entered the filter, and then collecting a series of samples from the effluent. The time when the Fluorescein was first added was noted, and a constant quantity sufficient to maintain a uniform color was allowed to jet into the filter influent for 30 minutes. At the same time samples were collected every minute from the effluent, and from the results the accompanying graph was plotted.

EFFLUENT COLOR CURVE



For this graph the influent color was denoted by 100 and the effluent samples graded according to this standard.

After 30 minutes, when the jet of Fluorescein into the filter influent was discontinued, effluent samples were taken every 5 minutes to ascertain how long a period elapsed before the color disappeared.

(3) *How Long to Waste Water After Cleaning*:

The question has been raised as to how long after starting the filter (following the cleaning) the filter effluent should be allowed to run to waste before collecting it for domestic purposes. The writer, in asking this question of some persons in charge of municipal plants, found that in general they had taken the Contractor's advice, and as a result the time allowed varied anywhere from 5 to 15 minutes after washing. The answer was usually "From five to ten minutes," and frequently "About five minutes."

In order to determine the important part which carelessness in regard to wasting water after cleaning the filter plays in filter operation, samples were taken every two minutes (June 15th to June 18th) from the fifth to the nineteenth minute after starting. The efficiency for each sample was calculated.

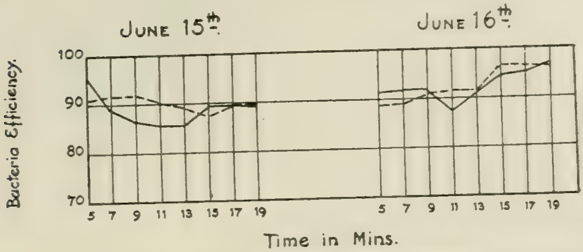
Graphs were plotted, these show that it was not until the eleventh minute after starting that the filter began to acquire its efficiency; and it was the fifteenth or seventeenth minute before efficiency was maintained. From these observations, I would suggest fifteen minutes as a minimum time in which the filter's effluent should waste before directing the filtered water into the mains. This information is of value in connection with the time required for various filter operations, and may be summarized as follows:—

(1) Average time for cleaning—11 minutes.

(2) Time required for filtered water to waste on starting—15 minutes.

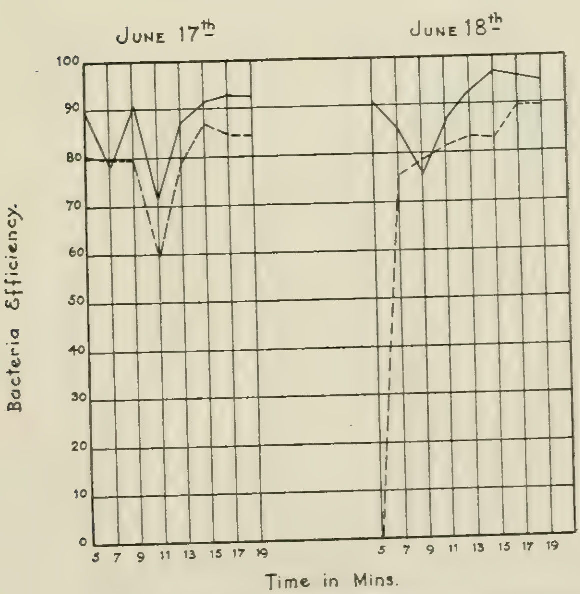
(3) Average time to place filter in operation after it has been stopped ready for cleaning—26 minutes.

EFFICIENCIES OF MECHANICAL FILTER ON STARTING.



Note:- Solid line denotes 37° C. Bacteria Efficiency.
Dotted - - 18°-22° C. - -

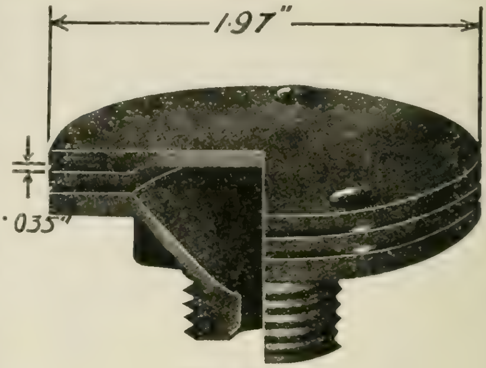
EFFICIENCIES OF MECHANICAL FILTER ON STARTING.



Note:- Solid line denotes 37° C. Bacteria Efficiency.
Dotted - - 18°-22° C - -

(4) *Loss of Head that could not be regained*:

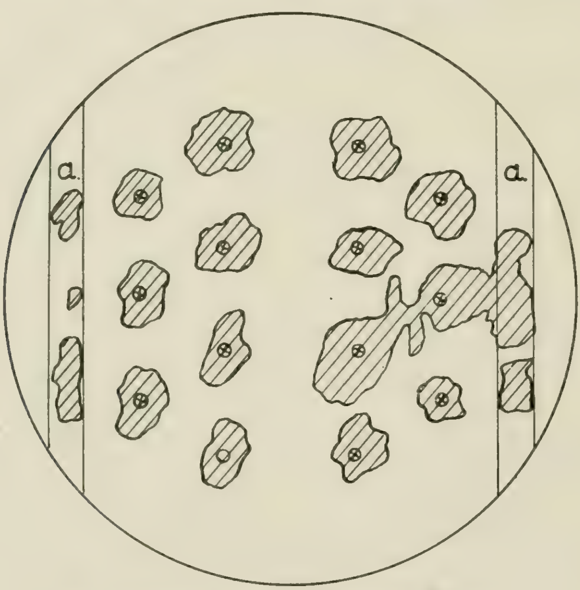
Beginning with the middle of February it was found that the head of water obtainable at the different orifices of the Mechanical Filter steadily becomes less and less. In three and a half months it had fallen from 6 feet to 2 feet 6 inches, consequently on June 1st an investigation into the cause was decided upon. In some filtration plants in the United States similar trouble had been experienced but in a modified form, and it was found that the removal of the copper wire gauze separating the sand from the gravel eliminated a portion of the trouble.



Sand Strainer.

This we proceeded to do, and in removing the gauze found that the mesh in patches was so compacted with sand that it prevented practically all water passing through. This was especially noticeable about the supports holding the screen and where the pieces of gauze overlapped.

SKETCH
SHOWING WHERE
SAND CLOGGED WIRE GAUZE.



⊗ Denotes position of standards that supported the wire gauze.

Hatched portions denote where wire gauze was clogged with sand

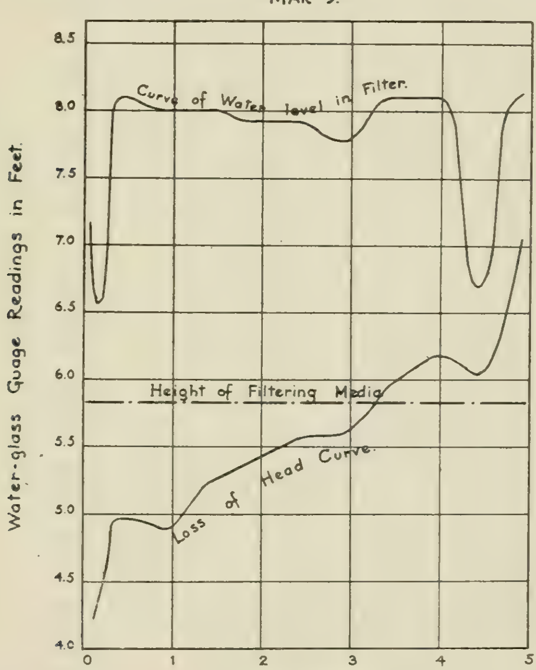
"a" Denotes where wire gauze overlapped

The figure illustrates the condition of the gauze as found. After the removal of the gauze the sand was replaced and the filter started anew. The removal of the gauze had not solved the problem, however, as an additional head of 6 inches only was gained. A thorough examination of all valves revealed nothing, and it

was then decided to remove the sand again and also the gravel, and to examine the sand strainers, which were the Hodkinson type of sand valve and 78 in number at the bottom of the filter.

After the sand and gravel had been removed, exposing the strainers, the wash water was turned on. It then became evident that some of the trouble was located, for while a portion of the strainers emitted water, others did not; and practically none of the strainers distributed it freely. An examination of the strainers disclosed the fact that sand had clogged them, not externally (filter side) as had been expected, but internally. The cause of the trouble arose from the wash-water and was due to sand present in the city mains. In operating the reverse-flow to the filter, the water had driven the sand into these strainers with such force that when the filter was put into operation, the pressure in the filter being slight (about 5 pounds compared with 40 pounds in the reverse-flow) the pressure was

COMPARISON
BETWEEN
WATER LEVEL IN FILTER AND LOSS OF HEAD
MAR 9th



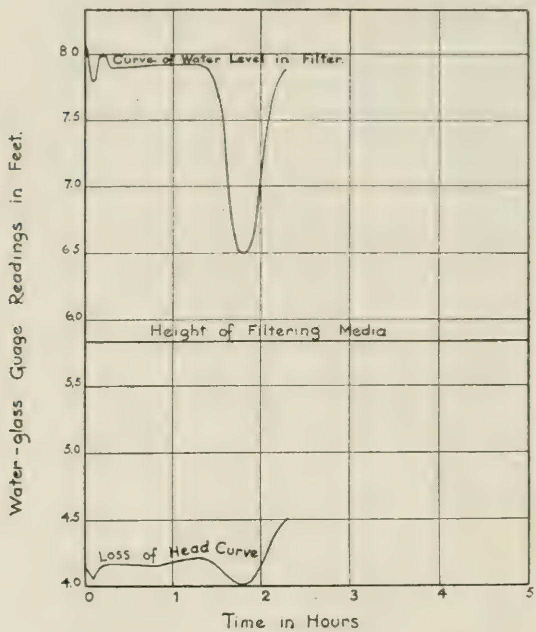
not sufficiently great to dislodge the sand. As a result, the available head at the effluent pipe of the filter gradually became less and less as more and more sand was compacted into the strainers.

All the strainers were removed and thoroughly cleaned by hand and replaced. Then with the gravel and sand restored, (the copper wire gauze now being omitted) the filter was started afresh.

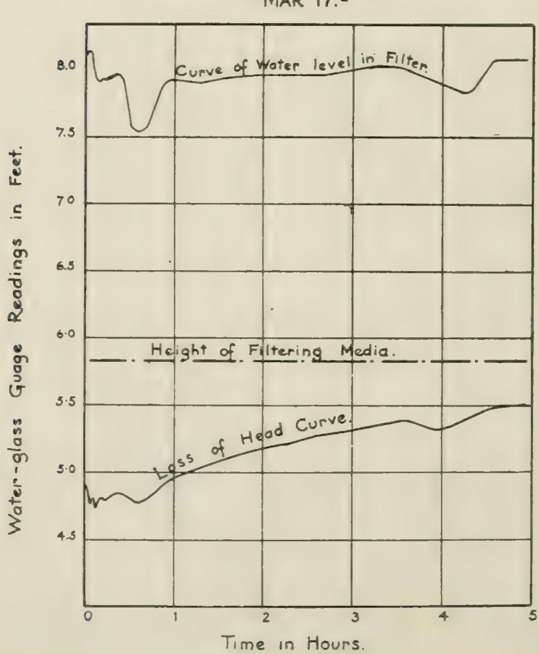
With these alterations the head at the effluent increased from 3 feet, which existed after the wire gauze was taken out, to 6 feet 6 inches.

Ordinarily sand will not be found in the wash water when filtered water is used, but in cases where it might occur (as it did at the Experimental Station) measures should be taken to entrap the sand instead of allowing it to collect and

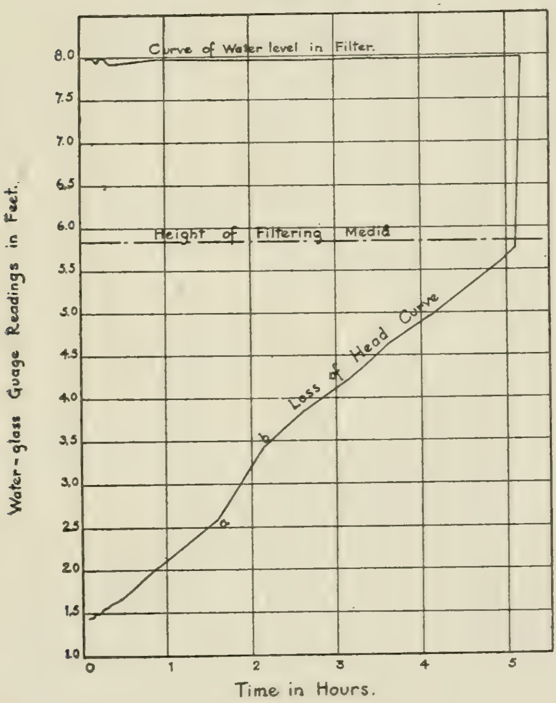
COMPARISON
BETWEEN
WATER LEVEL IN FILTER AND LOSS OF HEAD
MAR 10TH



COMPARISON
BETWEEN
WATER LEVEL IN FILTER AND LOSS OF HEAD
MAR 17TH



COMPARISON
BETWEEN
WATER LEVEL IN FILTER AND LOSS OF HEAD
JUNE 11th

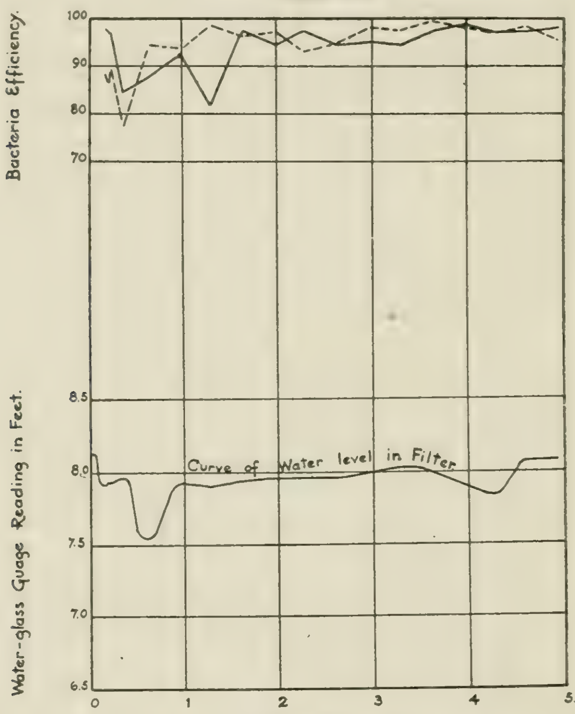


cause trouble in the draining system of the filter. By so doing, a source of disturbance will be eradicated which otherwise would ultimately end in stopping the filter, thereby necessitating loss of time and expense before the filter could be put into action again.

(5) *Effect of a Varying Head on the Filter:*

In operating the experimental filter, another feature which has a telling effect both on the "length of run" and the "efficiency," is the *stability of the head of water over the filtering media of sand.* Sometimes this effect is more marked than others and especially concerns the bacterial efficiency.

COMPARISON BETWEEN WATER LEVEL IN FILTER AND BACTERIA EFFICIENCY MAR. 17th



Note:- Solid line denotes 37°C. Bacteria Efficiency.
Dotted line " 18°-22°C. " "

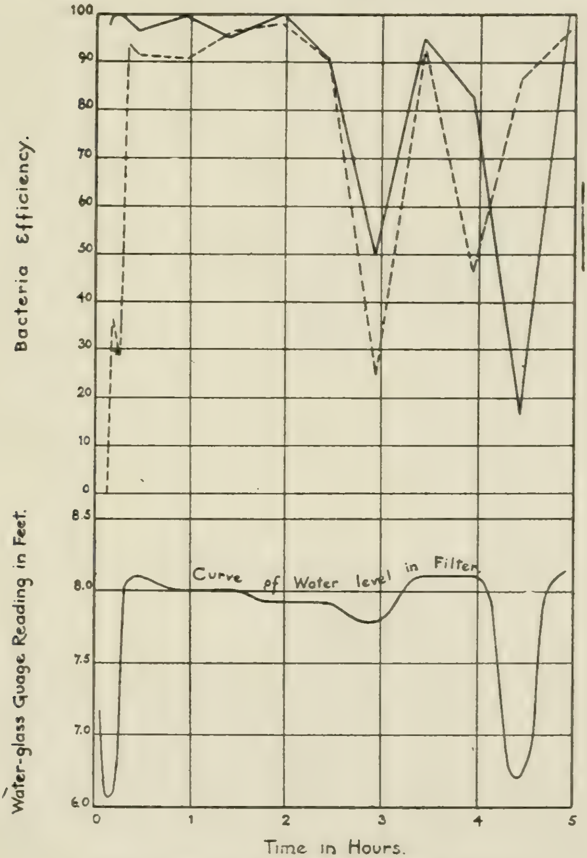
The results arising from a varying head were discovered to be detrimental to filter operation. A variation of a couple of inches does not appear to cause any appreciable disturbance in the behaviour, but with the head changing as much as a foot, noticeable results do ensue.

With reference to the length of run one should observe the graphs which give both the "head of water" over the filtering media, and the "loss of head" in the filter. On March 17th and June 11th are shown two graphs which are typical of the loss of head curves. One notices in these that when the loss of head is slow, as shown on March 17th, the curve representing the loss of head pertains to the line representing a parabolic curve, whereas, when the loss of head is more rapid (as

shown by the steeper curve for June 11th), the curve representing it approaches a straight line. With these typical curves let us contrast the graphs representing the loss of head for March 9th, and March 10th where great variation in the column of water over the filtering media takes place. On March 17th we see that a slight variation in the water-level curve causes a sympathetic variation in the loss of head curve. This variation in the latter however, being small, adjusts itself to its former state without any appreciable detriment to the final result of the curve. But on March 9th and 10th, where the variation in the water-level curve is some

COMPARISON BETWEEN WATER LEVEL IN FILTER AND BACTERIA EFFICIENCY

MAY 9th



Note:- Solid line denotes 37°C. Bacteria Efficiency
Dotted " " 18°-22°C "

sixteen inches, we find that the loss of head curve deviated remarkably from its normal path; and from experience the curve at such times never returns in that particular run to its apparent logical position. It appears then that there is in the water-level of a filter something which harmonizes fairly well to the modulus of elasticity in the strength of materials. The water-level of the filter can vary to a certain extent without any appreciable detriment to the loss of head. When, however, this variation increases it finally reaches a point which causes the loss of head

curve to fail. Where this point of variation begins for various sands is a subject for investigation in itself.

The graph for June 11th presents an interesting study, namely, that between the points "a" and "b," a period of half an hour, a large variation in the water-level has taken place. The loss of head curve has been raised $4\frac{1}{4}$ inches from its primary to its secondary course. Thus it appears that a variation in water-level was the direct and only cause for the loss of $4\frac{1}{4}$ inches of head, and ultimately reduced the length of this particular run of the filter some 30 or 40 minutes. It is accordingly apparent that the column of water over the filtering media should be kept constant.

Turning our attention to the bacteria efficiency of the filter, let us consider the results from two similar runs, namely March 9th and March 17th, on both of which days the filter was subjected to the same treatment as far as cleaning and chemicals added were concerned. On March 17th when there were only small variations in the water-level curve, the lines representing the bacteria efficiencies, outside of a few irregularities at the first of the run, are practically constant.

It is interesting to compare the bacteria efficiency line with the water-level curve for March 9th. Records of this run show that comparatively large variations occurred in the water column over the filtering media. A very noticeable feature of this curve is that when the water-level curve dips, almost invariably there is a similar drop in the efficiency curves. It is very probable that this presents an important factor in filter management, because, if in testing a mechanical gravity filter samples are taken only when the water-level has fallen from normal, the results probably underrate the true efficiency of the filter. Again, if all the samples are taken when the water-level is normal, you may overrate its efficiency; the result of this is that a higher efficiency is sometimes given a filter than it merits. For this there is but one cure, and that is to have the inflow and outflow under such complete control that the water-level in the filter remains definitely fixed.

(6) *Adding of Coagulant.*

Since all mechanical filters rely upon the coagulant to form their schmutzdecke, the addition of the coagulant is accordingly the most important feature in the management of a mechanical filtration plant.

One factor that must first be settled, is the chemical to be employed in treating the water. The experiments herein reported upon were confined to the use of alum, the commercial sulphate of aluminium, it being the most commonly used.

Another primary factor to be settled, is the manner and method of administering it to the water which is to be treated. Concerning the latter, the method adopted was to dissolve the alum in a known quantity of water and add it as a solution. In some plants a revolving worm is employed to convey the powdered chemical to the water, but as this would be almost impossible in a small plant, we adhered strictly to the adjustable orifice and solution method.

It has been explained under the heading "Description of Apparatus," that the coagulant is added to the water to be treated, just after it leaves the mixing-box. In this way the coagulant becomes fairly evenly distributed.

The table, "Methods and Bacteria Efficiencies," shows that when 0.5 grains of alum per gallon were used and the solution was not stirred, a better bacteria efficiency was attained than when the same quantity of alum was added but the alum solution stirred intermittently. It was even better than the results obtained when 0.75 grains of alum per gallon were used and the coagulant solution

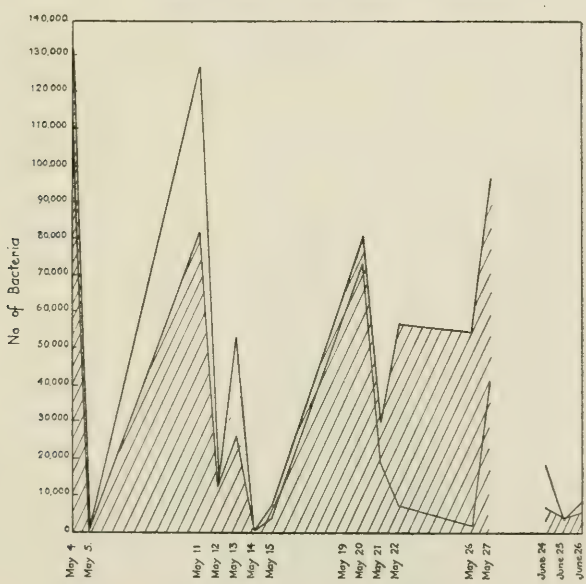
continually stirred, and almost on a par with the results obtained when 1.5 grains of alum per gallon were used and the coagulant solution stirred continually.

In small plants, such as this where a weak alum solution is made every twenty-four hours, a portion of the alum flocks after the solution is first made. This flocculant hydrate either redissolves or settles to the bottom of the tank, leaving a clear liquid.

At the end of two months the aluminium hydrate at the bottom of the solution tank had not increased in quantity, that is, the desired quantity of alum had been discharged into the water.

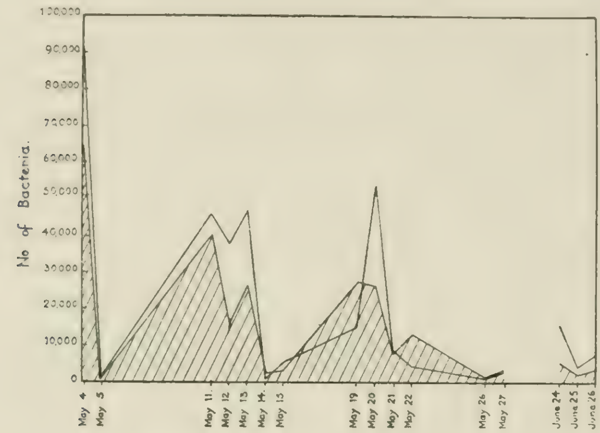
When the coagulant is administered in a clear solution to the water to be treated a flock is formed only after it reaches the raw water. The only difference arising out of the addition of the coagulant solution partially flocked or clear, is that a very real advantage is obtained in the latter case because of the flock forming in the raw water. Using an unflocked stock solution undoubtedly gives better bacteria efficiency. How this is obtained is not known definitely but the flock appears to envelope considerable numbers of the bacteria, and forms, with them as a nucleus, clumped masses, a portion of which settle in the sedimentation chamber, the balance being carried over to the filter to form the schmutzdecke.

REPRESENTATION OF
18°-22° BACTERIA COUNTS
BEFORE AND AFTER 2 HOURS STORAGE



Note:- Hatched portion shows count after storage.

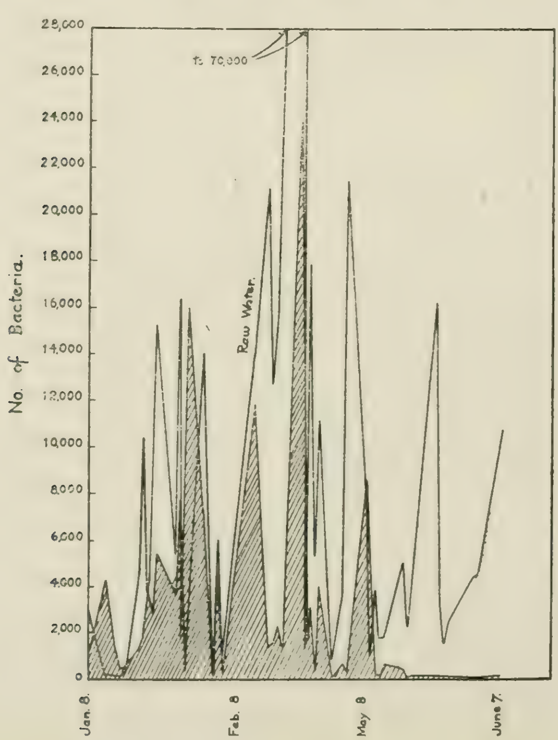
REPRESENTATION OF
37° BACTERIA COUNTS
BEFORE AND AFTER 2 HOURS STORAGE



Note:- Hatched portion shows count after storage.

When a flocked solution is added to the raw water, it is possible only to form mechanically an artificial strainer on the top of the sand, the bacterial suspension apparently not being affected by the settling of the flock in the sedimentation

GRAPH SHOWING
DAILY AVERAGE 18°-22° BACTERIA COUNTS
FOR SLOW SAND FILTER

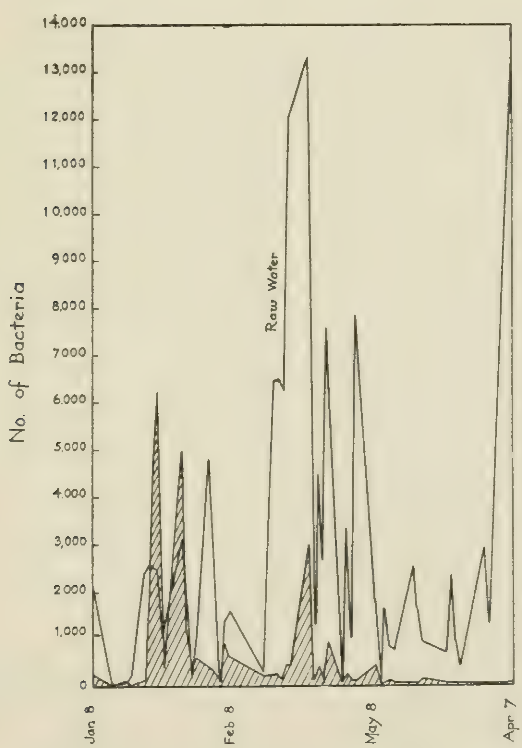


Note:- Hatched portion shows count after filtration.

chamber. It is probable that this explains the reduction due to sedimentation in many of the municipal plants.

The highest bacteria efficiencies of the table were obtained when, on starting the filter directly after cleaning, *filtered water, alum 3 grains, and soda ash 6 grains* per gallon were admitted to the filter for 5 minutes. This allowed a filament to form over the sand before any polluted water was served to it, and kept the lower part of the bed from becoming contaminated. After the 5 minutes the *filtered water* and the *soda ash* were discontinued. The water to be treated containing 3 grains of alum per gallon with the usual two hours storage was then allowed to pass to the filter. This method gave 98.8 and 98.9 per cent. efficiency. The slow sand filter which was run in conjunction with the mechanical filter using the same raw water gave an efficiency of 97.0 per cent. for 18-22 degrees C. bacteria and 97.8 per cent. for 37 degrees C. bacteria.

DAILY AVERAGE 37° BACTERIA COUNTS FOR SLOW SAND FILTER.

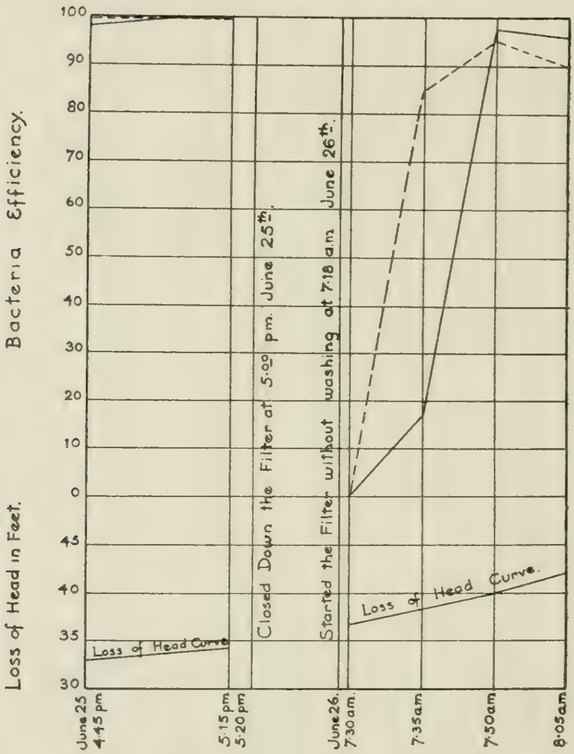


Note:- Hatched portion shows count after filtration.

(7) *Starting without Washing*:

Another question which arises is whether or not it is advisable to wash a filter after it has been shut down for several hours, the filter not having suffered a total loss-of-head before being shut down.

RESULTS
FROM STARTING A MECHANICAL FILTER
WITHOUT CLEANING
JUNE 25th and 26th

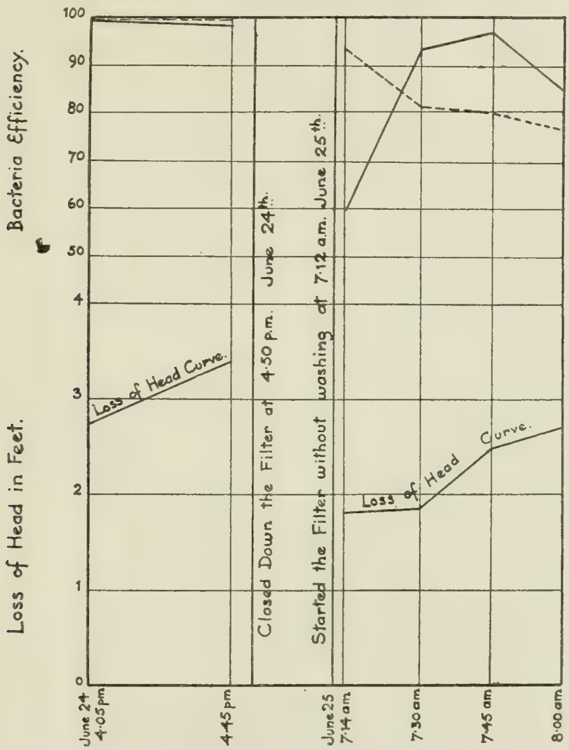


Note:- Solid line denotes 37°C Bacteria Efficiency
Dotted " " 18°-22° C " "

On June the 24th and 25th the filter was stopped at 5 p.m. and started again the next morning with the idea of ascertaining what effect this would have on the bacteria efficiency.

The efficiency curves are given together with the loss of head and time curves, in order that a clear impress of the effect may be obtained. The bacteria efficiency has been calculated for each sample, and the line joining the points representing the same becomes the efficiency curve.

RESULTS
FROM STARTING A MECHANICAL FILTER
WITHOUT CLEANING
JUNE 24th and 25th



Note:- Solid line denotes 37°C. Bacteria Efficiency.
Dotted " " 18°-22°C. " "

It is quite evident from the graphs that when a filter is once stopped it is advisable to wash it before putting it into use again. The bacteria efficiencies for the last 30 minutes before resting the filter in these experiments show an average of from 99.0 per cent. for the 37 degrees plates to 99.7 per cent. for the 18-22 degrees plates. After starting, the efficiency is observed to drop, and on June 26th when the filter was started, the efficiency was entirely lost. A most important observation is that for forty-five minutes after starting, in no case did the filter regain its original efficiency in contrast to what occurs after washing. It is evident that the practice of starting a filter without washing, as is the case in small plants where the filters are not used continuously, may mean serious interruptions in the filter efficiency.

MECHANICAL GRAVITY FILTER

Methods and Bacteria Efficiencies.

Methods.	Removal Efficiency for 18°-22°C Bacteria. per cent.	Removal Efficiency for 37°-40°C Bacteria. per cent.
Using Mech. Filter, like a slow sand filter, but running at higher rate (80,000,000 gals. per ac. per day	57.7	49.0
Mech. Filter using 0.5 grains Alum per gal. (Stock Alum solution not stirred)	92.3	93.6
Mech. Filter using 0.5 grains Alum per gal. (Stock Alum solution stirred intermittantly)	62.3	81.0
Mech. Filter using 0.75 grains Alum per gal. (Stock Alum solution stirred continually)	92.8	89.8
Mech. Filter using 1.50 grains Alum per gal. (Stock Alum solution, stirred continually)	91.7	94.5
Mech. Filter using Alum 1.5 grains and Lime 13 grains per gal. (Stirring of stock solutions discontinued)	68.6	78.1
Mech. Filter using Alum 1.5 grains and Lime 9 grains per gal.	95.4	95.8
Mech. Filter using Alum 1.5 grains and Soda Ash, 3 grains per gal.	92.4	91.6
Mech. Filter when *filtered water* and *Alum* 1.5 grains per gal. are admitted direct to filter for 5 minutes after cleaning, following which the filter treats *polluted water* containing alum, 1.5 grains per gal., with the usual 2 hours storage.	93.0	95.7
Mech. Filter when *filtered water*, *Alum* 3 grains, and *Soda Ash* 6 grains per gal. are admitted direct to filter for 5 minutes after cleaning, following which the filter treats polluted water containing Alum 3 grains per gal., with the usual 2 hours storage	98.8	98.9
Mech. Filter when *filtered water*, and Alum, 3 grains per gal., are admitted direct to filter for 5 minutes after cleaning. following which the filter treats polluted water containing Alum, 3 grains per gal., with the usual 2 hours storage..	96.2	97.8

Using Mechanical Filter like a Slow Sand Filter, but running at a higher rate.

(18°–22°C. count.)

Time Started.	Estimated. Length of run in hours.	Estimated. Gallons discharged per run.	Average Bacteria Efficiency per run.	Bacterial Counts. Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
Jan. 8th, 10.30 a.m..	22.0	22,000	10.7	560	280	410	600	60	366	10
Jan. 12th, 10.15 a.m.	216.0	324,000	62.6	1,920	2	381	1,520	2	143	45
Jan. 21st. 11.30 a.m.	23.5	35,250	17.7	720	80	288	680	40	235	8
Jan. 22nd, 11.00 a.m.	35.5	53,250	55.6	1,360	21	451	580	0	201	18
Jan. 27th, 10.00 a.m.	23.0	34,500	89.4	8,000	10	1.481	600	10	155	10
Jan. 28th, 10.00 a.m.	100.0	150,000	49.4	2,800	0	711	1,300	0	359	30
Feb. 2nd, 10.00 a.m.	108.0	162,000	74.5	4,000	0	955	2,400	0	243	31
Averages.........	75.4	113,100	57.7	....	....	641	....	....	233	....

(37°–40°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
Jan. 8th, 10.30 a.m..	22.0	22,00,	64.2	400	60	240	120	29	86	10
Jan. 12th, 10.15 a.m.	216.0	324,000	55.8	960	0	174	540	0	77	45
Jan. 21st, 11.30 a.m.	23.5	35,250	2.8	400	16	144	320	70	140	8
Jan. 22th, 11.00 a.m.	35.5	53,250	36.6	760	15	285	520	20	181	18
Jan. 27th, 10.00 a.m.	23.0	34.500	43.2	820	30	297	370	30	169	10
Jan. 28th, 10.00 a.m.	100.0	150.000	41.0	1,150	0	326	570	0	193	30
Feb. 2nd, 10.00 a.m.	108.0	162,000	63.1	2,200	0	522	760	0	193	31
Averages.........	75.4	113.100	49.0	....	....	286	....	....	145	....

Mechanical Filter using 0.5 grains Alum per gallon. (Stock Alum Solution not stirred.)

(18°–22°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
Feb. 16th, 10.15 a.m.	1.25	1,875	98.2	1,100	590	845	20	10	15	2
Feb. 16th, 11.45 a.m.	2.50	3,750	99.1	2,100	460	2,120	10	10	10	4
Feb. 17th, 10.00 a.m.	23.50	35,250	95.8	4,400	60	1,161	510	0	72	11
Feb. 18th, 10.00 a.m.	23.00	34,500	83.2	4,400	760	2,561	760	170	387	10
Feb. 19th, 9.45 a.m..	25.50	35,250	93.9	6,400	1,050	3,228	720	0	113	9
Averages.........	14.8	22,200	92.3	....	....	2,156	....	....	159	....

(37°–40°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
Feb. 16th, 10.15 a.m.	1.25	1,875	100.0	90	60	75	0	0	0	2
Feb. 16th, 11.45 a.m.	2.50	3,750	100.0	620	30	470	0	0	0	4
Feb. 17th, 10.00 a.m.	23.50	35,250	95.8	1.500	0	770	190	0	39	11
Feb. 18th, 10.00 a.m.	23.00	34,500	88.2	1,600	160	983	270	0	109	10
Feb. 19th, 9.45 p.m..	23.50	35,250	92.5	3,400	600	1,489	290	20	112	9
Averages.........	14.8	22,200	93.6	....	....	937	....	....	67	....

Mechanical Filter using 0.5 grains per gallon. (Stock Alum Solution stirred intermittently.)

(18°–22°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
Feb. 23rd, 11.30 a.m	22.0	33,000	63.1	16.000	20	8,545	4,400	30	2,957	11
Feb. 24th, 10.00 a.m.	20.0	30,000	9.4	330	0	95	470	10	85	9
Feb. 25th, 10.30 a.m.	26.5	39,750	85.3	4,600	850	2,673	2,800	10	389	15
Feb. 27th, 9.30 a.m..	40.0	60,000	90.9	32,000	1,100	5,830	600	30	302	10
Mar. 2nd, 9.30 a.m..	26.5	39,750	46.2	30	0	13	50	0	7	10
Averages.........	27	40,500	62.3	....	....	3,516	....	....	758	....

(37°–40°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
Feb. 23rd, 11.30 a.m.	22.0	33,000	91.6	3.200	20	1,214	470	20	115	11
Feb. 24th, 10.00 a.m.	20.0	30,000	60.0	270	0	83	80	10	33	9
Feb. 25th, 10.30 a.m.	26.5	39,750	89.8	1,450	360	852	210	10	87	15
Feb. 27th, 9.30 a.m..	40.0	60,000	82.4	1,200	40	373	170	10	66	10
Mar. 2nd, 9.30 a.m..	26.5	39,750	73.5	80	0	34	20	0	9	10
Averages.........	27	40,500	81.0	....	....	565	....	....	66	....

Mechanical Filter using 0.75 grains Alum per gallon (Stock Alum solution stirred continuously)

(18°–22°C. count.)

Time Started.	Estimated. Length of run in hours.	Estimated. Gallons discharged per run.	Average Bacteria Efficiency per run.	Bacterial Counts. Raw. Max.	Raw. Min.	Raw. Ave.	Filtered Max.	Filtered Min.	Filtered Ave.	Weight.
Mar. 3rd, 9.15 a.m.	9.0	13,500	98.1	2,100	0	909	60	0	17	10
Mar. 4th, 9.30 a.m.	8.0	12,000	89.0	1,400	280	781	520	10	86	10
Mar. 5th, 9.30 a.m.	9.0	13,500	97.6	1,900	1,100	1,640	70	20	40	5
Mar. 6tn, 9.30 a.m.	9.0	13,500	92.1	1,200	30	381	230	0	30	10
Mar. 9th, 10.45 a.m.	12.0	18,000	93.2	4,400	80	1,625	320	20	110	10
Mar. 10th, 9.00 a.m.	10.0	15,000	97.4	1,450	440	906	30	20	24	5
Mar. 11th, 10.20 a.m.	17.0	25,500	94.9	12,800	3,800	6,100	600	60	332	15
Mar. 12th, 9.00 a.m.	14.0	21,000	97.7	1,600	30	757	40	0	17	15
Mar. 13th, 10.20 a.m.	14.0	21,000	93.2	3.100	170	1,260	420	0	92	10
Mar. 17th, 9.45 a.m.	13.0	19,500	96.0	5,200	3,200	4,267	720	50	184	15
Mar. 18th, 10.00 a.m.	11.0	16,500	97.8	3,200	800	1,397	100	0	31	15
Mar. 19th, 9.45 a.m.	20.0	30,000	91.4	6,800	2,200	3,570	1,100	90	308	10
Mar. 24th, 9.50 a.m.	8.0	12,000	95.3	18,000	400	8,540	1,100	0	400	15
Mar. 25th, 9.45 a.m.	27.0	40,500	88.3	86,000	6,700	44,200	11,000	1,100	5,370	16
Mar. 26th, 10.20 a.m.	24.0	36,000	92.3	56,000	4,500	13,107	8,800	100	1,313	15
Mar. 27th, 9.50 a.m.	22.0	33.000	77.5	58,000	12,000	24,633	19,000	2,600	5,980	15
Averages.........	15.5	23,250	92.8	....	....	8,833	....	....	1,133	....

(37°–40°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw Max.	Raw Min.	Raw Ave.	Filtered Max.	Filtered Min.	Filtered Ave.	Weight.
Mar. 3rd, 9.15 a.m.	9.0	13,500	98.0	2,100	40	918	40	0	16	10
Mar. 4th, 9.30 a.m.	8.0	12,000	85.2	610	70	216	140	0	32	10
Mar. 5th, 9.30 a.m.	9.0	13,500	97.2	2,800	550	1,550	60	30	41	5
Mar. 6th, 9.30 a.m.	9.0	13,500	79.3	290	60	164	160	0	34	10
Mar. 9th, 10.45 a.m.	12.0	18,000	96.0	3,800	60	801	140	0	32	10
Mar. 10th, 9.00 a.m.	10.0	15,000	82.9	160	40	82	40	0	14	5
Mar. 11th, 10.20 a.m.	17.0	25,500	97.3	2,100	720	1,541	180	0	57	15
Mar. 12th, 9.00 a.m.	14,0	21,000	98.0	1,200	80	489	40	0	10	15
Mar. 13th, 10.20 a.m.	14.0	21,000	83.4	650	0	163	110	0	27	10
Mar. 17th, 9.45 a.m.	13.0	19,500	95.4	2,800	450	1,557	120	20	71	15
Mar. 18th, 10.00 a.m.	11.0	16,500	96.6	1,200	300	797	80	0	27	15
Mar. 19th, 9.45 a.m.	20.0	30,000	93.7	1,200	390	752	180	0	37	10
Mar. 24th, 9.50 a.m.	8.0	12,000	96.2	13,000	100	787	700	0	293	15
Mar. 25th, 9.45 a.m.	27.0	40,500	85.9	32,000	6,500	17,400	5,200	500	2,463	16
Mar. 26th, 10.20 a.m.	24.0	36,000	81.1	9,500	1,800	6,667	4,400	300	1,313	15
Mar. 27th, 9.50 a.m.	22.0	33,000	70.5	8,300	900	3,187	3,000	100	940	15
Averages.........	15.5	23,250	89.8	....	....	2,837	....	....	439	....

Mechanical Filter using 1.5 grains alum per gallon. (Stock alum solution stirred continuously).

(18°–22°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw Max.	Raw Min.	Raw Ave.	Filtered Max.	Filtered Min.	Filtered Ave.	Weight.
March 31st, 9.45 a.m.	16.0	24,000	82.8	42,000	11,000	17,600	15,000	500	3,030	10
April 1st, 10.00 a.m.	14.5	21,750	89.5	88,000	25,000	36,800	14,000	700	3,860	15
April 2nd, 10.00 a.m.	8.0	12,000	96.2	16,000	800	9,320	1,100	0	380	15
April 7th, 9.40 a.m.	10.0	15,000	95.4	32,000	8,400	18,160	3,100	0	827	15
Averages.........	12.1	18,150	91.7	....	....	20,749	....	....	1,933	....

(37°–40°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw Max.	Raw Min.	Raw Ave.	Filtered Max.	Filtered Min.	Filtered Ave.	Weight.
March 31st 9.45 a.m.	16.0	24,000	93.7	9,500	3,700	6,480	1,200	0	410	10
April 1st, 10.00 a.m.	14.5	21,750	91.9	10,500	4,800	6,853	1,500	0	627	15
April 2nd, 10.00 a.m.	8.0	12,000	94.4	6,700	1,800	3,833	1,100	0	217	15
April 7th, 9.40 a.m.	10.0	15,000	98.0	14,000	3,400	9,127	600	0	180	15
Averages.........	12.1	18,150	94.5	....	....	6,587	....	....	335	....

Mechanical Filter, using Alum 1.5 grains and Lime 13 grains per gallon.

18°–22°C. count.

Time Started.	Estimated. Length of run in hours.	Estimated. Gallons discharged per run.	Average Bacteria Efficiency per run.	Bacterial Counts. Raw. Max.	Raw. Min.	Raw. Ave.	Filtered Max.	Filtered Min.	Filtered Ave.	Weight.
May 11th, 2.00 p.m.	20.0	30,000	87.1	90,000	7,600	61,086	12,600	650	7,921	7
May 12th, 1.50 p.m.	22.0	33,000	77.1	44,000	1,400	22,210	23,000	0	5,080	10
May 13th, 2.10 p.m.	2.5	3,750	69.1	37,000	11,000	23,000	11,000	5,100	7,100	4
May 14th, 3.15 p.m.	21.5	32,250	28.6	9,500	400	3,483	4,200	400	2,625	6
May 15th, 1.50 p.m.	6.5	9,750	72.2	13,000	800	7,200	3,200	1,200	2,000	6
Averages.........	14.5	21,750	68.6	....	....	24,414	....	....	4,763	....

(37°–40°C. count.)

May 11th, 2.00 p.m.	20.0	30,000	72.7	38,000	4,800	21,943	8,200	2,800	6,000	7
May 12th, 1.50 p.m.	22.0	33,000	79.9	54,000	3,200	28,720	12,000	600	5,780	10
May 13th, 2.10 p.m.	2.5	3,750	74.3	18,000	9,000	13,250	4,800	1,900	3,400	4
May 14th, 2.15 p.m.	21.5	32,250	86.9	11,000	800	5,250	1,400	100	788	6
May 15th 1.50 p.m.	6.5	9,750	75.0	2,600	100	1,067	500	100	267	6
Averages.........	14.5	21,750	78.1	....	....	16,112	....	....	3,628	....

Mechanical Filter using Alum 1.5 grains and Lime 9 grains per gallon.

(18°–22°C. count.)

May 19th, 3.00 p.m.	19.0	28,500	92.3	136,000	46,000	83,667	12,000	1,900	6,467	6
May 21st, 2.15 p.m.	7.5	11,250	98.6	43,500	21,000	30,700	790	110	414	5
May 22nd, 2.30 p.m.	26.5	39,750	95.9	112,000	26,000	57,600	4,000	850	2,350	5
Averages.........	17.7	26,550	95.4	....	....	58,969	....	....	3,289	....

(37°–40°C. count.)

May 19th, 3.00 p.m.	19.0	28,500	95.3	68,000	22,000	34,417	2,400	1,100	1,633	6
May 21st, 2.15 p.m.	7.5	11,250	98.9	11,000	5,800	7,960	120	60	84	5
May 22nd, 2.30 p.m.	26.5	39,750	93.2	19,000	6,500	13,260	1,600	440	908	5
Averages.........	17.7	26,550	95.8	....	....	19,538	....	....	925	....

Mechanical Filter using Alum 15 grains, and Soda Ash 3 grains per gallon.

(18°–22°C. count.)

May 28th, 10.45 a.m.	7.5	11,250	98.8	172,000	47,000	97,600	1,700	550	1,162	5
May 29th, 12.30 a.m.	9.5	14,250	89.6	108,000	32,000	71,600	9,200	6,400	7,440	5
June 4th, 9.30 a.m.	4.0	6,000	91.4	88,000	24,000	56,250	10,800	1,650	4,813	8
June 5th, 9.15 a.m.	5.5	8,250	92.6	120,000	12,000	71,450	9,000	1,100	5,270	10
June 9th, 8.05 a.m.	7.5	11,250	91.6	20,500	1,900	10,510	2,000	40	886	10
June 10th, 8.00 a.m.	4.0	6,000	91.4	36,500	18,000	27,438	3,200	1,200	2,375	8
June 11th, 7.50 a.m.	5.0	7,500	92.8	19,000	2,400	8,230	2,000	0	597	10
Averages.........	6.2	9,300	92.4	....	....	43,150	....	....	3,001	....

(37°–40°C. count.)

May 28th, 10.45 a.m.	7.5	11,250	81.4	6,900	900	3,360	1,050	310	604	5
May 29th, 12.30 a.m.	9.5	14,250	89.6	6,100	800	3,240	520	170	336	5
June 4th, 9.30 a.m.	4.0	6,000	87.7	26,000	3,800	15,213	3,800	880	1,885	8
June 5th, 9 15 a.m.	5.5	8,250	95.1	17,000	800	7,100	1,200	20	351	10
June 9th, 8.05 a.m.	7.5	11,250	95.4	16,000	3,900	6,540	830	10	320	10
June 10th, 8.00 a.m.	4.0	6,000	95.3	23,000	9,600	18,575	2,550	90	865	8
June 11th, 7.50 p.m.	5.0	2,500	90.3	24,000	2,400	9,480	2,300	20	924	10
Averages.........	6.2	9,300	91.6	....	....	9,545	....	....	764	

Mechanical Filter when filtered water and alum 1.5 grains per gallon are admitted directly to filter for 5 minutes after cleaning, following which the filter treats polluted water containing alum 1.5 grains per gallon, having a storage of 2 hours.

(18°–22°C. count.)

Time Started.	Estimated. Length of run in hours.	Estimated. Gallons discharged per run.	Average Bacteria Efficiency per run.	Bacterial Counts. Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
June 15th, 8.30 a.m..	21.0	30,500	86.6	18,000	4,600	12,450	3,200	720	1,671	10
June 16th, 8.05 a.m..	15.5	23,250	93.7	72,000	10,500	37,600	6,400	480	2,353	10
June 18th, 8.00 a.m..	9.0	13,500	92.2	12,500	4,900	9,020	2,600	330	706	10
Averages.........	15.2	22,800	90.8 (93.0)	....	....	19,690	....	....	1,577	....

(37°–40°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
June 15th, 8.30 a.m..	21.0	30,500	84.7	8,200	3,900	5,910	1,500	140	917	10
June 16th, 8.05 a.m..	15.5	23,250	96.5	18,000	5,100	10,880	670	190	382	10
June 18th, 8.00 a.m..	9.0	13,500	94.9	11,000	1,200	7,180	910	140	369	10
Averages.........	15.2	22,800	92.0 (95.7)	....	....	7,990	....	....	556	....

NOTE.—As the filter had been shut down from June 11th to June 15th, the coagulant would have settled out of the water in the storage tank, thus the low efficiencies on June 15th. The figures in brackets () are fairer averages.

Mechanical Filter when filtered water, Alum 3 grains, and Soda Ash 6 grains per gallon are admitted direct to filter for 5 minutes after cleaning, following which the filter treats polluted water containing Alum 3 grains per gal., having a storage of 2 hours.

(18°-22°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
June 23rd, 7.50 a.m..	12.0	18,000	98.9	30,000	700	13,944	330	60	175	9
June 24th, 8.00 a.m..	7.5	11,250	98.5	9,500	100	4,380	240	0	63	10
June 25th, 8.50 a.m..	11.5	17,250	99.1	184,000	1,100	22,030	1,550	20	198	10
June 26th,	9.0	13,500	98.7	13,400	1,300	5,470	220	11	73	10
Averages.........	10.0	15,000	98.8	....	....	11,392	....	....	122	....

(37°-40°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
June 23rd, 7.50 a.m..	12.0	18,000	99.3	7,200	500	4,122	120	0	28	9
June 24th, 8.00 a.m..	7.5	11,250	98.4	9,100	100	4,130	290	10	67	10
June 25th, 8.50 a.m..	11.5	17,250	98.7	3,200	1,300	2,150	140	0	29	10
June 26th,	9.0	13,500	99.1	9,100	800	3,810	120	0	35	10
Averages.........	10.0	15,000	98.9	....	....	3,538	....	....	40	....

Mechanical Filter when filtered water and alum 3 grains per gallon are admitted direct to filter for 5 mins. after cleaning, following which the filter treats polluted water containing alum 3 grains per gallon having a storage of 2 hours.

(18°–22°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
July 13th, 8.40 a.m.	12.0	18,000	94.0	9,500	900	3,760	680	83	228	5
July 14th, 8.30 a.m.	12.0	18,000	98.4	24,000	18,000	20,300	460	240	330	5
July 15th, 8.15 a.m.	10.5	15,750	96.3	16,000	12,000	14,000	580	440	516	5
Averages	11.5	17,250	96.2	....	....	12,687	....	....	358	....

(37°–40°C. count.)

Time Started.	Length of run in hours.	Gallons discharged per run.	Average Bacteria Efficiency per run.	Raw. Max.	Raw. Min.	Raw. Ave.	Filtered. Max.	Filtered. Min.	Filtered. Ave.	Weight.
July 13th, 8.40 a.m.	12.0	18,000	98.6	1,800	100	760	14	8	10	5
July 14th, 8.30 a.m.	12.0	18,000	97.8	11,500	3,600	7,540	300	62	172	5
July 15th, 8.15 a.m.	10.5	15,750	97.1	4,500	2,200	3,020	180	36	88	5
Averages	11.5	17,250	97.8	....	....	....	....	....	....	....

OPERATING DATA, RAPID GRAVITY MECHANICAL FILTER AND SLOW SAND FILTER

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°–22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 January 8	10.30	......	1	0	0	0	......	560	560	60	29	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	11.00	......	2	......	......	......	......	420	600	260	120	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	11.30	......	3	......	......	......	2.23	380	400	210	34	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	12.00	......	4	......	......	......	2.23	560	160	820	90	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	1.30	5	......	......	......	2.27	280	220	400	120	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	2.00	6	......	......	......	2.27	280	200	200	95	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	2.30	7	......	......	......	2.27	360	280	320	110	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	3.00	8	......	......	......	2.29	420	480	110	70	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	3.30	9	......	......	......	2.29	420	360	240	100	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	4.00	10	......	......	......	2.33	420	400	280	90	......	......	......	+	+	+	+	......	......	......	+	+	+	+
January 12	9.40	......	(start)	Cleaned filter by passing in water and air for about 5 mins. Allowed sand to settle for 3½ mins. before setting filter to work.																					
	9.50	......	1	0	0	0	......	2,300	440	6	3	......	......	......	0	+	+	+	......	......	......	......	+	+	+
	9.51	......	2	......	......	......	......	......	200	......	35	......	......	......	......	......	......	......	......	......	......	......	+	+	+
	9.52	......	3	......	......	......	......	......	480	......	110	......	......	......	......	......	......	......	......	......	......	......	+	+	+
	9.55	......	4	......	......	......	......	240	280	......	45	......	......	......	0	+	+	+	......	......	......	......	+	+	+
	10.00	......	5	......	......	......	......	......	800	......	55	......	......	......	......	......	......	......	......	......	......	......	+	+	+
	10.15	......	6	......	......	......	......	440	60	34	6	......	......	......	0	0	0	0	......	......	......	......	+	+	+
	10.45	......	7	......	......	......	......	180	80	35	2	......	......	......	0	0	+	+	......	......	......	......	0	+	+
	11.15	......	8	......	......	......	......	85	35	11	3	......	......	......	0	0	+	+	......	......	......	......	0	0	0
	11.45	......	9	......	......	......	......	65	33	6	0	......	......	......	+	0	+	+	......	......	......	......	0	0	0
	......	1.45	10	......	......	......	......	47	27	52	3	......	......	......	0	0	0	0	......	......	......	......	0	0	0
	......	2.15	11	......	......	......	......	9	14	8	2	......	......	......	0	0	0	0	......	......	......	......	0	0	0
	......	2.45	12	......	......	......	......	28	45	6	0	......	......	......	0	0	0	0	......	......	......	......	0	0	0
	......	3.15	13	......	......	......	......	12	32	5	2	......	......	......	0	0	0	0	......	......	......	......	0	0	0
	......	3.45	14	......	......	......	......	40	38	12	11	......	......	......	0	0	0	0	......	......	......	......	0	0	0
	......	4.15	15	......	......	......	......	18	15	1	12	......	......	......	0	0	0	0	......	......	......	......	0	0	0
January 15	9.45	......	1	......	......	......	3.02	2	6	0	2	......	......	......	0	0	0	0	......	......	......	......	......	......	......
	10.15	......	2	......	......	......	3.02	5	11	4	0	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	10.45	......	3	......	......	......	3.02	23	53	3	3	......	......	......	0	+	0	0	......	......	......	0	+	+	+
	11.15	......	4	......	......	......	3.02	51	33	1	0	......	......	......	0	0	0	+	......	......	......	0	+	0	+
	11.45	......	5	......	......	......	3.10	14	16	0	2	......	......	......	0	0	0	+	......	......	......	0	0	0	+
	......	1.15	6	......	......	......	3.13	4	1	0	1	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	......	1.45	7	......	......	......	3.06	3	6	1	0	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	......	2.15	8	......	......	......	3.00	4	21	2	1	......	......	......	0	0	0	+	......	......	......	0	0	0	+
	......	2.45	9	......	......	......	3.00	72	20	24	1	......	......	......	+	+	0	+	......	......	......	0	+	+	+
	......	3.15	10	......	......	......	3.08	200	35	25	5	......	......	......	+	+	0	+	......	......	......	+	+	+	+

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°–22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 January 16	9.30	......	1	0	0	0	3.10	11	8	3	3	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	10.00	......	2	......	......	......	3.10	7	18	1	5	......	......	......	0	0	0	0	......	......	......	0	0	0	+
	10.30	......	3	......	......	......	3.10	43	9	5	0	......	......	......	0	+	+	+	......	......	......	0	0	0	0
	11.00	......	4	......	......	......	3.13	23	1	8	3	......	......	......	0	0	0	+	......	......	......	0	0	0	+
	11.30	......	5	......	......	......	3.27	13	2	0	3	......	......	......	0	0	0	+	......	......	......	0	0	0	+
	12.00	......	6	......	......	......	3.27	41	46	2	0	......	......	......	0	0	0	+	......	......	......	0	0	0	0
	......	1.30	7	......	......	......	3.29	42	17	3	0	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	......	2.00	8	......	......	......	3.31	23	37	2	2	......	......	......	0	0	0	+	......	......	......	0	0	0	0
	......	2.30	9	......	......	......	3.17	360	52	260	45	......	......	......	+	+	0	+	......	......	......	+	+	+	+
	......	3.00	10	......	......	......	3.17	180	47	140	130	......	......	......	0	0	0	+	......	......	......	+	+	+	+
January 19	......	11.00	The surface of the sand in the filter became dry, due to influent being shut off.																						
	......	2.00	1	0	0	0	3.67	1.120	880	560	480	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	2.30	2	......	......	......	3.65	1.280	760	960	540	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	3.00	3	......	......	......	3.65	1.680	1.120	960	200	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	3.30	4	......	......	......	3.65	440	1.520	800	200	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	4.00	5	......	......	......	3.65	1.920	880	840	360	......	......	......	+	+	+	+	......	......	......	+	+	+	+
January 20	9.30	......	1	0	0	0	4.67	(spr.	(spr.)	(spr.)	(spr.)	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	10.00	......	2	......	......	......	4.69	320	(spr.)	(spr.)	480	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	10.30	......	3	......	......	......	4.71	26	20	7	(spr.)	......	0	+	+	+	+	+	......	0	0	+	+	+	+
	11.00	......	4	......	......	......	4.73	71	26	130	85	......	0	+	+	+	+	+	......	0	0	0	+	+	+
	11.30	......	5	......	......	......	4.75	1,280	48	640	280	......	0	+	+	+	+	+	......	0	+	+	+	+	+
	12.00	......	6	......	......	......	4.75	1,680	56	180	88	......	0	+	+	+	+	+	......	0	+	+	+	+	+
	......	2.00	7	......	......	......	5.00	1,440	132	180	300	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	......	2.30	8	......	......	......	5.00	1,600	98	720	45	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	......	3.00	9	......	......	......	5.02	1,520	52	520	340	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	......	3.30	10	......	......	......	5.02	960	28	340	280	......	0	0	+	+	+	+	......	0	0	+	+	+	+
January 21	9.30	......	1	0	0	0	6.15	......	......	......	......	......	0	0	0	+	+	+	......	0	0	0	+	+	+
	10.00	......	2	......	......	......	8.21	......	......	......	......	......	0	0	0	+	+	+	......	0	0	0	0	+	+
			(start) Cleaned filter for 5 mins., allowed sand to settle for 3½ mins. before setting filter to work.																						
	11.23	......	3	0	0	0	......	160	95	640	1.010	......	0	0	0	+	+	+	......	0	0	0	+	+	+
	11.25	......	4	......	......	......	......	......	1.460	......	130	......	......	......	......	......	......	......	......	0	0	0	0	+	+
	11.35	......	5	......	......	......	......	380	880	160	320	......	0	0	0	+	+	+	......	0	0	0	+	+	+
	14.45	......	6	......	......	......	......	440	40	190	70	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	12.00	......	7	......	......	......	......	160	120	400	185	......	+	+	+	+	+	+	......	0	+	+	+	+	+
	......	2.00	8	......	......	......	......	640	380	130	110	......	0	0	+	+	+	+	......	0	+	+	+	+	+
	......	2.30	9	......	......	......	......	720	120	87	120	......	0	+	+	+	+	+	......	0	0	+	+	+	+
	......	3.00	10	......	......	......	......	520	95	86	155	......	0	0	+	+	+	+	......	0	0	+	+	+	+
January 22	9.30	......	1	0	0	0	6.08	80	63	16	78	......	0	0	0	0	+	+	......	0	0	0	+	+	+
	10.00	......	2	......	......	......	8.73	360	195	64	84	......	0	0	0	0	+	+	......	0	0	0	+	+	+
			(start) Cleaned filter for 5 mins., allowed sand to settle for 3 mins. before starting filter working																						
	10.46	......	3	0	0	0	......	680	1.250	115	140	......	0	+	+	+	+	+	......	0	0	0	0	+	+
	10.47	......	4	......	......	......	......	......	620	......	440	......	......	......	......	......	......	......	......	0	0	+	+	+	+

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Colon Bacilli: 0 = negative reaction; + = positive reaction

Date.	Hour. A.M.	Hour. P.M.	Serial No.	Grains of Chemicals added per U.S. gallon. Alum.	Soda Ash.	Lime.	Max. loss of Head.	Bacterial Counts. 18°-22° C Inf.	18°-22° C Eff.	37° C Inf.	37° C Eff.	Colon Bacilli. Influent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	Effluent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 January 22	10.48	......	5	......	......	......	......	......	110	......	100	......	......	......	......	......	......	......	......	0	0	+	+	+	+
	10.49	......	6	......	......	......	......	......	160	......	210	......	......	......	......	......	......	......	......	0	0	+	+	+	+
	10.50	......	7	......	......	......	......	......	110	......	310	......	......	......	......	......	......	......	......	0	0	+	+	+	+
	11.00	......	8	......	......	......	......	760	140	760	360	......	0	0		+			......	0	0	+	+	+	+
	11.30	......	9	......	......	......	......	240	0	760	280	......	0	0		+			......	0	0	+	+	+	+
	12.00	......	10	......	......	......	......	220	0	280	460	......	0	0		+	+		......	0	0	+	+	+	+
	......	1.30	11	......	......	......	2.31	1,360	10	440	300	......	0			+	+		......	0	0	+	+	+	+
	......	2.00	12	......	......	......	2.31	760	60	480	520	......	0	0		+	+		......	0	0	+	+	+	+
	......	2.30	13	......	......	......	2.31	280	410	140	470	......	0	0		+	+		......	0	+	+	+	+	+
	......	3.00	14	......	......	......	2.33	280	60	230	70	......	0	0		+	+		......	0	0	+	+	+	+
	......	3.30	15	......	......	......	2.40	160	0	175	50	......	0			+	+		......	0	0	0	+	+	+
January 23	9.00	......	1	0	0	0	3.04	330	580	124	90	......	0	0	0	0	+	......	......	0	0	0	+	+	......
	9.30	......	2	......	......	......	2.79	21	80	24	40	......	0	0	0	0	0	......	......	0	0	0	0	+	......
	10.30	......	3	......	......	......	2.74	360	170	15	20	......	0	0	0	0	0	......	......	0	0	0		+	......
	11.00	......	4	......	......	......	3.02	360	70	96	70	......	0	0	0	0		......	......	0	0	0		+	......
	11.30	......	5	......	......	......	2.96	680	560	290	210	......	0	0		0		......	......	0	0	0		+	......
	12.00	......	6	......	......	......	2.94	680	220	190	90	......	0	0		0		......	......	0	0	0		+	......
	......	1.30	7	......	......	......	2.96	640	240	230	60	......	0	0		0		......	......	0	0			+	......
	......	2.00	8	......	......	......	3.04	620	420	320	60	......	0	0		0		......	......	0	0			+	......
	......	2.30	9	......	......	......	2.96	560	170	340	60	......	0			0		......	......	0	0			+	......
	......	3.00	10	......	......	......	2.96	720	420	240	50	......	0	0		0		......	......	0	0			+	......
January 27	9.31	......	1 (start)	0	0	0	......	1,950	10	1,900	1,800	......							......	0	0	0		+	+
	9.32	......	2	......	......	......	......	......	140	......	370	......	......	......	......	......	......	......	......	0	0			+	+
	9.33	......	3	......	......	......	......	......	160	......	380	......	......	......	......	......	......	......	......	0				+	+
	9.34	......	4	......	......	......	......	......	0	......	390	......	......	......	......	......	......	......	......	0	0			+	+
	9.35	......	5	......	......	......	......	......	950	......	210	......	......	......	......	......	......	......	......	0	0			+	+
	9.37	......	6	......	......	......	......	......	580	......	220	......	......	......	......	......	......	......	......	0	0			+	+
	9.40	......	7	......	......	......	2.60	420	230	1,450	370	......	0	0					......	+				+	+
	9.45	......	8	......	......	......	2.60	......	90	......	260	......	......	......	......	......	......	......	......	0				+	+
	10.00	......	9	......	......	......	2.63	8,000	380	250	360	......	0	0	+			......	......	0	0			+	......
	10.30	......	10	......	......	......	2.69	3,600	600	820	370	......	0		+		+	......	......	0				+	......
	11.00	......	11	......	......	......	2.69	1,300	140	190	220	......	0	0	+		+	......	......	0	0			+	......
	11.30	......	12	......	......	......	2.71	530	90	280	190	......	0	0	+		+	......	......	0	0			+	......
	12.00	......	13	......	......	......	2.71	620	30	610	280	......	0		+		+	......	......	0	+			+	......
	......	2.06	14	......	......	......	2.75	150	30	290	30	......	0	0	+		+	......	......	0	0			+	......
	......	2.30	15	......	......	......	2.79	480	220	80	150	......	0	0	+		+	......	......	0	0			+	......
	......	3.15	16	......	......	......	2.94	80	20	30	30	......	0	0	+		+	......	......	0	0	0	0	+	......
	......	3.45	17	......	......	......	2.98	10	30	70	30	......	0	0	+		+	......	......	0	0		0	+	......
	......	4.15	18	......	......	......	3.04	40	10	50	30	......	0	0	+		+	......	......	0	0	0		+	......

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 January 28	9.33	......	(start) 1	0	0	0	......	......	170	......	580	......	......	......	......	......	......	......	......	0	0	0	0	+	+
	9.34	......	2	......	......	......	......	......	680	......	620	......	......	......	......	......	......	......	......	0	0	0	+	+	+
	9.35	......	3	......	......	......	......	310	190	110	350	......	0	0	0	+	+	+	......	0	0	+	+	+	+
	9.37	......	4	......	......	......	......	......	160	......	370	......	......	......	......	......	......	......	......	0	0	0	+	+	+
	9.39	......	5	......	......	......	......	......	340	......	680	......	......	......	......	......	......	......	......	0	0	0	0	+	+
	9.41	......	6	......	......	......	......	......	540	......	60	......	......	......	......	......	......	......	......	0	0	0	+	+	+
	9.43	......	7	......	......	......	2.74	200	200	110	90	......	0	0	0	+	+	+	......	0	0	0	+	+	+
	9.45	......	8	......	......	......	2.79	......	190	......	90	......	......	......	......	......	......	......	......	0	0	0	+	+	+
	10.00	......	9	......	......	......	2.91	410	560	50	10	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	10.30	......	10	......	......	......	2.75	510	780	110	80	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	11.00	......	11	......	......	......	2.79	2,100	810	860	330	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	11.30	......	12	......	......	......	2.94	1,800	640	850	440	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	12.00	......	13	......	......	......	2.79	1,900	240	1.050	320	......	0	+	+	+	+	......	......	+	+	+	+	+	......
	......	12.30	14	......	......	......	2.75	2,800	880	880	510	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	......	1.00	15	......	......	......	2.79	2,200	810	1,150	530	......	+	+	+	+	+	......	......	+	+	+	+	+	......
	......	1.30	16	......	......	......	2.92	2,450	920	1.050	320	......	+	+	+	+	+	......	......	+	+	+	+	+	......
	......	2.00	17	......	......	......	2.92	1,900	960	750	560	......	+	+	+	+	+	......	......	+	+	+	+	+	......
	......	2.30	18	......	......	......	2.92	1,500	330	950	450	......	0	+	+	+	+	......	......	0	+	+	+	+	......
January 29	9.00	......	1	0	0	0	3.02	20	40	10	50	......	0	0	0	0	+	......	......	0	0	0	0	+	......
	9.30	......	2	......	......	......	2.98	40	360	0	280	......	0	0	0	0	0	......	......	0	0	0	+	+	......
	10.00	......	3	......	......	......	3.10	0	20	10	0	......	0	0	0	0	0	......	......	0	0	0	0	+	......
	10.30	......	4	......	......	......	3.04	10	20	20	0	......	0	0	0	0	0	......	......	0	0	0	0	+	......
	11.00	......	5	......	......	......	2.98	0	0	20	0	......	0	0	0	0	0	......	......	0	0	0	+	+	......
	11.30	......	6	......	......	......	2.98	80	10	10	0	......	0	0	0	0	0	......	......	0	0	0	0	+	......
	12.00	......	7	......	......	......	2.98	110	10	30	10	......	0	0	0	0	0	......	......	0	0	0	0	+	......
	......	1.00	8	......	......	......	3.06	0	0	0	10	......	0	0	0	0	0	......	......	0	0	0	0	+	......
	......	1.30	9	......	......	......	3.01	30	0	0	0	......	0	0	0	0	+	......	......	0	0	0	0	0	......
	......	2.00	10	......	......	......	3.00	0	0	10	0	......	0	0	0	0	0	......	......	0	0	0	0	+	......
January 30	9.00	......	1	0	0	0	3.38	80	240	0	20	......	0	0	0	+	+	......	......	0	0	0	0	0	......
	9.30	......	2	......	......	......	3.38	860	1,300	220	110	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.00	......	3	......	......	......	3.38	280	450	160	380	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.30	......	4	......	......	......	3.46	430	180	310	570	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	11.00	......	5	......	......	......	3.38	320	210	290	160	......	0	0	+	+	+	......	......	0	+	+	+	+	......
	11.30	......	6	......	......	......	3.33	440	780	260	110	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	12.00	......	7	......	......	......	3.50	130	90	220	90	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	......	1.00	8	......	......	......	3.42	380	90	180	80	......	0	0	+	+	+	......	......	0	+	+	+	+	......
	......	1.30	9	......	......	......	3.44	300	30	170	200	......	+	+	+	+	+	......	......	+	+	+	+	+	......
	......	2.00	10	......	......	......	3.46	230	10	170	160	......	0	+	+	+	+	......	......	0	+	+	+	+	......
February 2..........	......	......	(start)	After cleaning filter allowed sand to settle for 3 mins.																					
	9.32	......	1	0	0	0	......	......	1.350	......	60	......	......	......	......	......	......	......	......	0	0	0	0	+	+
	9.33	......	2	......	......	......	......	1.600	4.800	420	140	......	0	0	0	+	+	+	......	0	0	0	+	+	+
	9.35	......	3	......	......	......	2.85	......	780	......	90	......	......	......	......	......	......	......	......	0	0	+	+	+	+

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
February 2..........	9.37	......	4	......	......	......	2.83	......	360	......	50	......	......	......	......	......	......	......	......	0	0	0	+	+	
	9.39	......	5	......	......	......	2.83	......	400	......	40	......	......	......	......	......	......	......	......	0	0	0	0	+	+
	9.41	......	6	......	......	......	2.83	......	240	......	30	......	......	......	......	......	......	......	......	0	0	0	+	+	+
	9.43	......	7	......	......	......	2.85	280	340	30	120	......	0	0	0	0	0		......	0	0	0	0	+	+
	9.45	......	8	......	......	......	2.85	......	180	......	30	......	......	......	......	......	......	......	......	0	0	0	+	+	+
	10.00	......	9	......	......	......	2.85	1.150	2.400	90	10	......	......	......	......	......	......	......	......	0	0	0	0	0	+
	10.30	......	10	......	......	......	2.88	110	190	40	0	......	0	0	0	0	0	......	......	0	0	0	0	+	+
	11.00	......	11	......	......	......	2.90	1.650	240	170	140	......	0	0	+	+	+	......	......	0	0	+	+	+	+
	11.30	......	12	......	......	......	2.90	3.200	760	1.900	370	......	0	+	+	+	+	......	......	0	+	+	+	+	+
	12.00	......	13	......	......	......	2.90	3.800	220	1.550	360	......	0	+	+	+	+	......	......	0	0	+	+	+	+
	......	12.30	14	......	......	......	2.88	2.800	780	1.200	430	......		+	+	+	+	......	......	+		+	+	+	+
	......	1.00	15	......	......	......	2.96	4.000	700	2.000	390	......	0	+	+	+	+	......	......	0	+	+	+	+	+
	......	1.30	16	......	......	......	2.96	2.400	430	2.200	400	......	0	+	+	+	+	......	......	0	+	+	+	+	+
	......	2.00	17	......	......	......	2.98	3.000	310	1.600	760	......	+	+	+	+	+	......	......	0	+	+	+	+	+
	......	2.30	18	......	......	......	2.98	2.600	320	1.200	440	......	+	+	+	+	+	......	......	0	+	+	+	+	
February 4..........	9.15	......	1	0	0	0	3.81	70	30	0	0	......	0	0	0	+	+	......	......	0	0	0	+	+	......
	9.45	......	2	......	......	......	3.83	20	40	30	20	......	0	0	0	+	+	......	......	0	0	+	+	+	......
	10.15	......	3	......	......	......	3.85	10	30	10	60	......	0	0	0	+	+	......	......	0	0	+	+	+	......
February 5..........	10.00	......	1	0	0	0	4.39	20	60	30	(spr.)	......	0	0	0	+	+	......	......	0	0	+	+	+	......
	10.30	......	2	......	......	......	4.23	520	110	40	50	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	11.00	......	3	......	......	......	4.27	860	180	390	260	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	11.30	......	4	......	......	......	4.27	950	220	110	140	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	12.00	......	5	......	......	......	4.29	730	80	350	340	......	0	+	+	+	+	......	......		+	+	+	+	......
	......	1.00	6	......	......	......	4.38	410	80	90	50	......	0	+	+		+	......	......	0	+	+	+	+	......
	......	1.30	7	......	......	......	4.50	40	50	30	20	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	......	2.00	8	......	......	......	4.54	270	40	350	50	......		+	+	+	+	......	......	0	0	+	+	+	......
February 6..........	9.00	......	1	0	0	0	5.13	20	90	0	30	......	0	0	0	0	0	......	......	0	0	+	+	+	......
	9.30	......	2	......	......	......	5.15	60	60	60	10	......	0	0	0	0	+	......	......	0	0	+	+	+	......
	10.00	......	3	......	......	......	5.19	90	40	30	10	......	0	0	0	+	+	......	......	0	0	0	+	+	......
	10.30	......	4	......	......	......	5.21	120	30	1.000	380	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	11.00	......	5	......	......	......	5.25	20	0	20	220	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	11.30	......	6	......	......	......	5.40	420	10	380	140	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	12.00	......	7	......	......	......	5.42	210	10	220	210	......	0	+	+	+	+	......	......		+	+	+	+	......
	......	1.00	8	......	......	......	5.52	10	0	470	160	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	......	1.30	9	......	......	......	5.58	30	20	200	240	......	0	+	+	+	+	......	......		+	+	+	+	......
	......	2.00	10	......	......	......	5.67	0	10	430	280	......	0	+	+	+	+	......	......	0	+	+	+	+	......

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0=negative reaction +=positive reaction													
								18°–22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 February 13.........	10.15	......	Began adding alum for the first time. Using ¾ grains per gal. Stock solution of coagulant not stirred.																						
	......	......	Began using two water gauges instead of the "Loss of Head" float.																						
	10.30	......	1	0.75	0	0	4.33	460	50	40	30	......	......	0	0	0	0	+	......	......	0	0	0	+	+
	11.00	......	2	......	......	......	4.29	1,900	720	340	0	......	......	0	0	0	0	+	......	......	0	0	0	0	+
	11.30	......	3	......	......	......	4.17	1,600	580	260	60	......	......	0	0	+	+	+	......	......	0	0	+	+	+
	12.00	......	4	......	......	......	4.27	1,800	1,200	150	40	......	......	0	0	0	0	+	......	......	0	0	0	0	+
	......	12.30	5	......	......	......	4.25	5,400	1,600	260	20	......	......	0	0	+	+	+	......	......	0	0	0	0	+
	......	1.00	6	......	......	......	4.25	3,200	630	20	10	......	......	0	0	+	0	+	......	......	0	0	0	0	+
	......	1.30	7	......	......	......	4.48	7,200	1,700	160	30	......	......	0	0	0	0	+	......	......	0	0	0	0	+
	......	2.00	8	......	......	......	4.56	5,800	1,150	50	30	......	......	0	0	0	0	+	......	......	0	0	0	0	+
	......	2.30	9	......	......	......	4.77	1,400	1,100	30	0	......	......	0	0	0	0	+	......	......	0	0	0	0	0
	......	3.00	10	......	......	......	4.92	1,600	920	40	30	......	......	0	0	0	0	0	......	......	0	0	0	0	0
NOTE. With a storage of 2 hours it is evident that with the alum being added for only 15 min. no coagulant would be in the water that was first transmitted to the filter at the beginning of the run. Hence we would expect a low bacteria efficiency.																									
February 16.........			(start)	Cleaned filter and allowed sand to settle for 3 mins.																					
	9.45	......	1	0.75	0	0	2.88	......	40	......	70	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	9.46	......	2	......	......	......	2.83	......	120	......	60	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	9.48	......	3	......	......	......	2.92	......	140	......	40	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	9.50	......	4	......	......	......	3.00	330	350	120	20	......	0	0				......	......	0	0	0	0	+	......
	9.52	......	5	......	......	......	3.10	......	10	......	10	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	9.54	......	6	......	......	......	3.13	......	160	......	0	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	9.56	......	7	......	......	......	3.56	1,400	240	10	20	......	0	0	+	+	+	......	......	0	0	0	0	+	......
	10.00	......	8	......	......	......	3.92	......	60	......	0	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	10.15	......	9	......	......	......	4.98	1,100	20	90	0	......	0	0		+	+	......	......	0	0	0	0	0	......
	10.45	......	10	......	......	......	6.35	590	10	60	0	......	0	0	0	+	+	......	......	0	0	0	0	0	......
	11.15	......	......	Head lost			8.13	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
			(start)	Cleaned filter and allowed sand to settle for 1 min.																					
	11.24	......	11	......	......	......	2.96	......	50	......	0	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	11.25	......	12	......	......	......	3.00	310	60	20	0	......	0	0		+	+	......	......	0	0	0	0	+	......
	11.27	......	13	......	......	......	3.21	......	80	......	20	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	11.29	......	14	......	......	......	3.23	......	60	......	10	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	11.31	......	15	......	......	......	3.29	......	10	......	0	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	11.33	......	16	......	......	......	3.35	......	20	......	0	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	11.35	......	17	......	......	......	3.44	190	60	......	0	......	0	0	0			......	......	0	0	0	0	0	......
	11.37	......	18	......	......	......	3.50	......	70	......	10	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	11.45	......	19	......	......	......	3.88	460	10	30	0	......	0	0	0	+	+	......	......	0	0	0	0	0	......
	......	12.15	20	......	......	......	5.00	780	10	90	0	......	0	0	+	+	+	......	......	0	0	0	0	0	......
	......	12.45	21	......	......	......	6.08	900	10	180	0	......	0	0	+	+	+	......	......	0	0	0	0	0	......
	......	1.45	22	......	......	......	6.71	2,100	10	620	0	......	+	+	+	+	+	......	......	0	0	0	0	+	......
	......	2.15	......	0	0	0	8.13	Stopped adding coagulants (alum). Strength = ¾ grains per gallon.																	
	......	4.15	......	......	......	......	2.96	Cleaned filter and allowed sand to settle for 5 mins.																	
	......	4.30	......	0.5	0	0	Began adding coagulant (alum). Strength = ½ grain ger gal.																		

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A. M.	P. M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 February 17..........			(start)	Cleaned filter.																					
	9.43	......	1	0.5	0	0	......	......	40	......	70	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	9.44	......	2	......	......	......	3.17	......	50	......	10	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.46	......	3	......	......	......	3.25	1,600	240	350	20	......	0	0				......	......	0	0	+	+	+	......
	9.48	......	4	......	......	......	3.21	......	160	......	50	......	......	......	......	......	......	......	......	0	0		+	+	......
	9.50	......	5	......	......	......	3.56	......	420	......	40	......	......	......	......	......	......	......	......	0	0		+	+	......
	9.52	......	6	......	......	......	3.65	......	540	......	30	......	......	......	......	......	......	......	......	0	0		+	+	......
	9.54	......	7	......	......	......	3.73	720	220	140	30	......	0					......	......	0	0	0	+	+	......
	9.56	......	8	......	......	......	3.71	......	120	......	80	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	10.00	......	9	......	......	......	3.85	350	70	0	20	......	0	0			+	......	......	0	0	0	0	0	......
	10.30	......	10	......	......	......	4.21	380	0	180	0	......	0	0			+	......	......	0	0	0	0	0	......
	11.00	......	11	......	......	......	4.58	650	10	230	0	......	0	0			+	......	......	0	0	0	0	+	......
	11.30	......	12	......	......	......	4.83	230	510	290	190	......	0	+			+	......	......	0	+	0	+	+	......
	12.00	......	13	......	......	......	5.17	1,400	70	1,500	20	......	0	+			+	......	......	0	0		+	+	......
	......	12.30	14	......	......	......	5.50	4,400	50	1,300	10	......		+			+	......	......	0	0		+	+	......
	......	1.00	15	......	......	......	5.79	3,200	30	550	20	......		+			+	......	......	0	0		+	+	......
	......	1.30	16	......	......	......	6.21	2,600	0	1,200	40	......					+	......	......	0	0		+	+	......
	......	2.00	17	......	......	......	6.60	2,800	10	1,300	0	......	0				+	......	......	0	0		+	+	......
	......	2.30	18	......	......	......	7.00	2,200	220	1,350	30	......					+	......	......	0	+		+	+	......
February 18..........	9.15	......	1	0.5	0	0	0.33	60	20	20	0	......	0	0			..	......	......	0	0		+	+	......
	9.44	......	(start)	Stopped cleaning filter.																					
	9.44	......	2	0.5	0	0	......	......	120	......	0	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.45	......	3	......	......	......	4.63	......	50	......	10	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.47	......	4	......	......	......	3.65	8,800	110	550	70	......	0					......	......	0	+		+	+	......
	9.49	......	5	......	......	......	3.58	......	220	......	50	......	......	......	......	......	......	......	......	0	+		+	+	......
	9.51	......	6	......	......	......	3.58	......	280	......	50	......	......	......	......	......	......	......	......	0	0		+	+	......
	9.53	......	7	......	......	......	3.58	......	280	......	20	......	......	......	......	......	......	......	......	0	0		+	+	......
	9.55	......	8	......	......	......	3.63	2,400	200	480	60	......	0					......	......	0	+		+	+	......
	9.57	......	6	......	......	......	3.67	......	280	......	39	......	......	......	......	......	......	......	......	0	0		+	+	......
	10.00	......	10	......	......	......	3.73	760	170	370	0	......	+	0				......	......	0	0	0	+	+	......
	10.30	......	11	......	......	......	3.81	1,100	210	850	170	......	0	+				......	......	0	0		+	+	......
	11.00	......	12	......	......	......	3.81	950	480	1,100	270	......	0	+				......	......	0	0		+	+	......
	11.30	......	13	......	......	......	3.81	2,800	380	1,450	40	......	0	+				......	......	0			+	+	......
	12.00	......	14	......	......	......	3.88	2,400	360	160	110	......		+	+			......	......	0			+	+	......
	......	12.30	15	......	......	......	3.92	2,200	320	1,200	90	......		+				......	......	0			+	+	......
	......	1.00	16	......	......	......	3.98	4,400	760	950	160	......		+				......	......	0	0		+	+	......
	......	1.30	17	......	......	......	4.33	4,200	650	1,050	70	......		+				......	......	0			+	+	......
	......	2.00	18	......	......	......	4.42	3,200	380	1,100	60	......	0	+				......	......	0	0		+	+	......

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°–22° C		37° C		Influent.							Effluent.						
	A. M.	P. M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 February 19	9.00	......	1	0.5	0	0	7.29	3,600	170	1,600	120	......	0	0	0			......	......	0	0	0	0	0	......
	9.18	......	(start)	Stopped cleaning filter.																					
	9.18	......	2	0.5	0	0	......	......	120	......	20	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	9.19	......	3	......	......	......	3.27	......	270	......	40	......	......	......	......	......	......	......	......	0	0	0	+		......
	9.21	......	4	......	......	......	3.25	8,000	560	1,400	330	......	0	0		+	+	......	......	0	+	0	+	+	......
	9.23	......	5	......	......	......	3.52	......	390	......	370	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.25	......	6	......	......	......	3.67	......	360	......	460	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.27	......	7	......	......	......	3.71	......	200	......	220	......	......	......	......	......	......	......	......	0	+	0	+	+	......
	9.29	......	8	......	......	......	3.75	1,700	330	5,600	330	......	0	+	+		+	......	......	0	0	+	+	+	......
	9.31	......	9	......	......	......	3.75	......	190	......	370	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.45	......	10	......	......	......	3.83	2,000	600	600	290	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.15	......	11	......	......	......	3.88	4,400	330	1,200	80	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	10.45	......	12	......	......	......	4.00	4,800	80	3,400	240	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	11.15	......	13	......	......	......	4.06	1,600	70	1,900	40	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	11.45	......	14	......	......	......	4.17	6,400	720	1,400	80	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	......	15.15	15	......	......	......	4.23	2,800	50	1,600	20	......	0	+	+	+		......	......	+	+	+	+	+	......
	......	12.45	16	......	......	......	4.27	3,200	40	1,300	170	......	+	+	+	+		......	......	0	0	+	+	+	......
	......	1.15	17	......	......	......	4.38	2,800	0	1,100	30	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	......	1.45	18	......	......	......	4.46	1,050	30	900	60	......	+	+	+	+		......	......	0	0	+	+	+	......
February 20	......	......	......	Installed a stirring device in the coagulant tank. Due to imperfect installation the coagulant (alum) was stirred only intermittantly.																					
February 23	11.04	......	(start)	Stopped cleaning filter.																					
	11.04	......	1	0.5	0	0	......	......	90	......	0	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	11.05	......	2	......	......	......	3.19	......	180	......	100	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	11.07	......	3	......	......	......	3.33	14.400	1.000	4.800	950	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	11.09	......	4	......	......	......	3.31	......	1.200	......	560	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	11.11	......	5	......	......	......	3.39	......	1.300	......	580	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	11.13	......	6	......	......	......	3.29	......	1.200	......	520	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	11.15	......	7	......	......	......	3.27	14.400	3.600	7.200	310	......	0	+		+	+	......	......	0	+	+	+	+	......
	11.17	......	8	......	......	......	3.29	......	6.400	......	1.700	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	11.30	......	9	......	......	......	3.35	3.800	2.200	3.200	80	......	0	+	+	+	+	......	......	0	+	0	+	+	......
	12.00	......	10	......	......	......	3.35	1.000	2.500	240	470	......	0	+	+	+		......	......	0	0	+	+	+	......
	......	12.30	11	......	......	......	3.44	11.200	3.600	3.200	160	......	+	+	+	+	+	......	......	+	+	+	+	+	......
	......	1.00	12	......	......	......	3.60	7.200	4.400	550	190	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	......	1.30	13	......	......	......	3.79	16.000	3.200	1.500	80	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	2.00	14	......	......	......	3.85	12,000	4.400	1.200	80	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	2.30	15	......	......	......	3.92	16.000	2.600	1.400	40	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	......	3.00	16	......	......	......	3.85	11,200	3,200	650	90	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	......	3.30	17	......	......	......	4.04	8.400	3.600	650	40	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	4.00	18	......	......	......	4.10	7.200	2.800	750	20	......	+	+	+	+	+	......	......	0	+	+	+	+	......
February 24	9.00	......	1	0.5	0	0	8.11	20	30	20	20	......	0	0	+	+	+	......	......	0	0	0	+	+	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0=negative reaction +=positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
February 24, 1914....	9.42	......	(start)	Stopped cleaning filter.																					
	9.42	......	2	0.5	0	0	......	......	10	......	70	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	9.43	......	3	......	......	......	3.42	......	60	......	50	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.45	......	4	......	......	......	3.42	30	60	1,100	120	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	9.47	......	5	......	......	......	3.35	......	40	......	60	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.49	......	6	......	......	......	3.38	......	20	......	70	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.51	......	7	......	......	......	3.38	......	10	......	90	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.53	......	8	......	......	......	3.40	10	0	250	140	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	9.55	......	9	......	......	......	3.48	......	10	......	90	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	10.00	......	10	......	......	......	3.46	160	470	60	80	......	0	+	0	+	+	......	......	0	0	+	+	+	......
	10.30	......	11	......	......	......	3.42	330	20	270	10	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	11.00	......	12	......	......	......	3.58	180	30	160	70	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	11.30	......	13	......	......	......	3.60	70	30	90	30	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	12.00	......	14	......	......	......	3.67	20	140	40	20	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	......	12.00	15	......	......	......	3.67	30	10	20	40	......	0	0	+	+	+	......	......	0	+	+	+	+	......
	......	1.00	16	......	......	......	3.67	0	20	70	20	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	......	1.30	17	......	......	......	3.92	50	30	40	20	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	......	2.00	18	......	......	......	3.04	10	20	0	10	......	0	0	+	+	+	......	......	0	0	+	+	+	......
February 25..........	10.06	......	(start)	Stopped cleaning filter																					
	10.06	......	1	0.5	0	0	......	......	70	......	30	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	10.08	......	2	......	......	......	......	......	210	......	90	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	10.10	......	3	......	......	......	......	1,600	950	550	220	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	10.13	......	4	......	......	......	3.23	......	740	......	190	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	10.15	......	5	......	......	......	3.23	......	1,200	......	130	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	10.17	......	6	......	......	......	3.40	......	850	......	160	......	......	......	......	......	......	......	......	+	0	+	+	+	......
	10.19	......	7	......	......	......	3.40	1,450	820	420	50	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	10.21	......	8	......	......	......	3.40	......	190	......	50	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	10.30	......	9	......	......	......	3.38	3,800	1,600	480	210	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	11.00	......	10	......	......	......	3.48	4,400	2,800	360	120	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	11.30	......	11	......	......	......	3.52	4,200	80	870	80	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	12.00	......	12	......	......	......	3.54	4,600	110	900	120	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	......	12.30	13	......	......	......	3.65	3,800	30	550	70	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	1.00	14	......	......	......	3.71	4,000	820	1,300	60	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	1.30	15	......	......	......	3.85	1,650	90	1,300	30	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	......	2.00	16	......	......	......	3.92	1,900	40	1,100	40	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	2.30	17	......	......	......	3.98	1,600	30	630	30	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	......	3.00	18	......	......	......	4.00	1,800	30	540	30	......	0	+	+	+	+	......	......	0	0	+	+	+	......
February 26..........	9.30	......	1	0.5	0	0	6.38	8,900	10	1,450	10	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	10.00	......	2	......	......	......	6.44	1,300	50	1,000	90	......	0	+	+	+	+	......	......	0	0	+	+	+	......

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0=negative reaction + =positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
February 26, 1914....	10.30	......	3	......	......	......	6.50	1,200	90	850	140	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	11.00	......	4	......	......	......	6.54	1,100	30	700	140	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	11.30	......	5	......	......	......	6.81	850	20	460	130	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	1.00	......	Head lost			8.13	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
February 27..........	8.31	......		Stopped cleaning filter.																					
	8.51	......	1 (start)	0.5	0	0	......	......	380	......	20	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	3.32	......	2	......	......	......	3.29	......	......	......	90	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	8.34	......	3	......	......	......	3.27	......	800	......	390	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	8.36	......	4	......	......	......	3.42	8,800	1,600	1,800	580	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	8.38	......	5	......	......	......	3.50	......	3,200	......	290	......	......	......	......	......	......	......	......	+	+	+	+	+	......
	8.40	......	6	......	......	......	3.54	......	4,400	......	460	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	8.42	......	7	......	......	......	3.50	9,600	4,200	6,400	420	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	8.44	......	8	......	......	......	3.58	......	1,800	......	280	......	......	......	......	......	......	......	......	+	+	+	+	+	......
	9.00	......	9	......	......	......	3.65	32000	480	1,200	10	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	9.30	......	10	......	......	......	3.73	5,200	450	370	20	......	0	0	+	+	......	......	......	0	0	0	0	+	......
	10.00	......	11	......	......	......	3.85	4,400	180	240	90	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	10.30	......	12	......	......	......	4.04	3,200	420	140	20	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	11.00	......	13	......	......	......	4.15	3,200	510	250	80	......	0	0	+	+	......	......	......	0	+	+	+	+	......
	11.30	......	14	......	......	......	4.23	2,800	600	620	150	......	+	+	+	+	......	......	......	0	+	+	+	+	......
	12.00	......	15	......	......	......	4.35	3,200	140	290	170	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	......	12.30	16	......	......	......	4.46	2,400	140	230	30	......	0	+	+	+	......	......	......	+	+	+	+	+	......
	......	1.00	17	......	......	......	4.54	1,900	70	40	80	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	......	1.30	18	......	......	......	4.73	1,100	30	550	10	......	+	+	+	+	......	......	......	0	+	+	+	+	......
March 2..............	9.30	......	1	0.5	0	0	4.17	0	10	0	10	......	0	0	0	0	......	......	......	0	0	0	0	0	......
	10.00	......	2	......	......	......	4.19	0	0	20	10	......	0	0	0	0	......	......	......	0	0	0	0	0	......
	10.30	......	3	......	......	......	4.26	30	0	10	0	......	0	0	+	+	......	......	......	0	0	0	0	+	......
	11.00	......	4	......	......	......	4.52	0	0	40	20	......	0	0	0	0	......	......	......	0	0	0	0	0	......
	11.00	......	5	......	......	......	5.60	0	0	80	10	......	0	0	0	0	......	......	......	0	0	0	0	0	......
	12.00	......	6	......	......	......	5.54	0	0	20	0	......	0	0	0	0	......	......	......	0	0	0	0	0	......
	......	12.30	7	......	......	......	5.50	30	50	50	20	......	0	0	0	0	......	......	......	0	0	0	0	0	......
	......	1.06	8	......	......	......	5.56	30	10	30	20	......	0	0	0	0	......	......	......	0	0	0	0	0	......
	......	1.30	9	......	......	......	5.63	20	0	40	0	......	0	0	0	0	......	......	......	0	0	0	0	0	......
	......	2.00	10	......	......	......	5.81	20	0	70	0	......	0	0	0	+	......	......	......	0	0	0	0	0	......
	......	2.00	Started adding ¾ grains of coagulant per gal. This is the first time while stock solution was stirred.																						
March 3..............	8.48	......	Stopped cleaning filter.																						
	8.48	......	1 (start)	0.75	0	0	......	......	0	......	0	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	8.49	......	2	......	......	......	3.54	......	80	......	20	......	......	......	......	......	......	......	......	0	0	+	0	+	......
	8.51	......	3	......	......	......	3.52	70	60	70	10	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	8.53	......	4	......	......	......	3.52	......	20	......	10	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	8.57	......	5	......	......	......	3.52	......	190	......	90	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	8.59	......	6	......	......	......	3.52	......	90	......	20	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.01	......	7	......	......	......	3.52	10	30	140	50	......	0	0	+	+	+	......	......	0	0	0	+	+	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0=negative reaction												+=positive reaction	
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 March 3	9.03	......	8	......	......	......	3.52	......	0	......	10	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.15	......	9	......	......	......	3.52	0	0	40	20	......	0	0	0	+	......	......	......	0	0	+	+	+	......
	9.45	......	10	......	......	......	3.58	660	0	610	0	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	10.15	......	11	......	......	......	3.60	2,100	60	1,050	10	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	10.45	......	12	......	......	......	3.73	1,250	10	1,300	20	......	+	+	+	+	......	......	......	0	+	+	+	+	......
	11.15	......	13	......	......	......	3.79	1,350	30	720	40	......	+	+	+	+	......	......	......	0	+	+	+	+	......
	11.45	......	14	......	......	......	3.88	1,200	20	1,550	10	......	+	+	+	+	......	......	......	0	+	+	+	+	......
	......	12.15	15	......	......	......	3.96	1,250	20	1,200	20	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	......	12.45	16	......	......	......	4.00	800	0	2,100	10	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	......	1.15	17	......	......	......	4.08	300	30	470	20	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	......	1.45	18	......	......	......	4.21	180	0	140	30	......	0	+	+	+	......	......	......	0	0	0	+	+	......
March 4	9.14		(start)	Stopped cleaning filter.																					
	9.14	......	1	0.75	0	0	......	......	72	......	16	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	9.15	......	2	......	......	......	3.56	......	1,800	......	19	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	9.17	......	3	......	......	......	3.54	1,460	880	1,100	72	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	9.19	......	4	......	......	......	3.48	......	1,220	......	140	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.21	......	5	......	......	......	3.54	......	1,400	......	130	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.23	......	6	......	......	......	3.58	......	1,200	......	165	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.25	......	7	......	......	......	3.63	2,000	840	880	82	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	9.27	......	8	......	......	......	3.63	......	720	......	135	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.30	......	9	......	......	......	3.60	1,400	520	610	140	......	0	0	0	+	......	......	......	0	0	+	+	+	......
	10.30	......	10	......	......	......	3.81	280	20	80	40	......	0	0	0	+	......	......	......	0	0	0	0	+	......
	10.30	......	11	......	......	......	3.88	410	70	130	10	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	11.00	......	12	......	......	......	3.94	520	110	290	40	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	11.30	......	13	......	......	......	3.98	320	60	220	10	......	0	0	0	+	......	......	......	0	0	0	+	+	......
	12.00	......	14	......	......	......	4.02	1,100	30	180	10	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	......	12.36	15	......	......	......	4.13	1,350	20	190	50	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	......	1.00	16	......	......	......	4.19	650	10	70	20	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	......	1.30	17	......	......	......	4.29	950	10	280	0	......	0	+	0	+	......	......	......	0	0	0	+	+	......
	......	2.00	18	......	......	......	4.54	830	10	110	0	......	0	0	0	+	......	......	......	0	0	0	0	0	......
March 5	9.07	......	(start)	Stopped cleaning filter.																					
	9.07	......	1	0.75	0	0	......	......	0	......	270	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	9.08	......	2	......	......	......	3.94	......	10	......	40	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.10	......	3	......	......	......	3.96	6,000	40	8,400	80	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	8.12	......	4	......	......	......	4.21	......	640	......	330	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.14	......	5	......	......	......	4.33	......	2,400	......	320	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.16	......	6	......	......	......	4.50	......	510	......	170	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.18	......	7	......	......	......	4.56	4,200	150	5,200	80	......	+	+	+	+	+	......	......	0	0	+	+	+	......

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
March 5	9.20	......	8	......	......	......	4.60	......	180	......	60	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.30	......	9	......	......	......	4.73	1,900	20	1,300	60	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	10.00	......	10	......	......	......	4.92	1,900	40	550	30	......	0	0	+	+	+	......	......	0	0	0	+	+	......
	10.30	......	11	......	......	......	5.06	1,550	70	1,500	50	......	0	0	+	+	+	......	......	0	0	0	+	+	......
	11.00	......	12	......	......	......	5.27	1,400	50	2,800	30	......	0		+	+		......	......	0	0	0	+		......
	11.30	......	13	......	......	......	5.40	1,450	20	1,600	50	......	+	+	+	+	+	......	......	0	+	+	+	+	......

NOTE.—(1) Stirrer of the stock coagulant solution had stopped during the night.
NOTE.—(2) As the filter was not overflowing an increased quantity of coagulant was present in the storage tank.

Date.	A.M.	P.M.	Serial No.	Alum.	Soda Ash.	Lime.	Max. loss of Head.	18°-22° C Inf.	18°-22° C Eff.	37° C Inf.	37° C Eff.	Inf. .001 c.c.	Inf. .01 c.c.	Inf. .1 c.c.	Inf. 1 c.c.	Inf. 5 c.c.	Inf. 25 c.c.	Inf. 50 c.c.	Eff. .001 c.c.	Eff. .01 c.c.	Eff. .1 c.c.	Eff. 1 c.c.	Eff. 5 c.c.	Eff. 25 c.c.	Eff. 50 c.c.
March 6	9.01	......	(start)	Stopped cleaning filter.																					
	9.01	......	1	0.75	0	0	......	......	......	......	40	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	9.02	......	2	......	......	......	......	......	......	......	30	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.04	......	3	......	......	......	......	......	......	1,600	120	......	+	0	+		+	......	......	0	0	+	+	+	......
	9.06	......	4	......	......	......	......	......	......	......	230	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.08	......	5	......	......	......	......	......	150	......	......	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.10	......	6	......	......	......	......	......	340	......	......	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.12	......	7	......	......	......	......	1,200	190	......	......	......	0	+	+	+	+	......	......	0	0	0	+	+	......
	9.14	......	8	......	......	......	......	......	50	......	......	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.30	......	9	......	......	......	......	50	230	90	80	......	0	0	0	+	......	......	......	0	0	+	+	+	......
	10.00	......	10	......	......	......	......	80	40	80	10	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	10.30	......	11	......	......	......	......	30	0	210	20	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	11.00	......	12	......	......	......	......	150	10	290	20	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	11.30	......	13	......	......	......	......	260	0	200	30	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	12.00	......	14	......	......	......	......	850	10	180	10	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	......	12.30	15	......	......	......	......	1,200	10	190	160	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	......	1.00	16	......	......	......	......	1,100	0	280	0	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	......	1.30	17	......	......	......	......	50	0	60	0	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	......	2.00	18	......	......	......	......	40	0	60	10	......	0	0	+	+	......	......	......	0	0	0	+	+	......
March 9	10.20	......	(start)	Stopped cleaning filter																					
	10.30	......	1	0.5	0	0	......	......	10	......	30	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	10.22	......	2	......	......	......	4.25	......	200	......	10	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	10.24	......	3	......	......	......	4.17	......	1,100	......	60	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	10.26	......	4	......	......	......	4.21	1,800	190	1,100	40	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	10.29	......	5	......	......	......	4.35	......	1,800	......	30	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	10.32	......	6	......	......	......	4.50	......	1,400	......	30	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	10.36	......	7	......	......	......	4.63	2,200	1,600	2,600	20	......	+		+	+	+	......	......	0	0	+	+	+	......
	10.29	......	8	......	......	......	4.92	......	140	......	30	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	10.45	......	9	......	......	......	4.9.	4,200	320	3.800	140	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	11.15	......	10	......	......	......	4.88	2,600	240	2,400	10	......	0	+	+	+	+	......	......	0	0	0	+	+	......
	11.45	......	11	......	......	......	5.23	4,400	140	550	30	......	0	+	+	+	+	......	......	0	0	0	0	+	......
	......	16.15	12	......	......	......	5.40	2,200	40	380	0	......	0	+	+	+	+	......	......	0	0	0	0	+	......
	......	12.45	13	......	......	......	5.56	700	60	330	30	......	0	0	+	+	+	......	......	0	0	0	0	0	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
March 9	......	1.15	14	......	......	......	5.58	80	60	80	40	......	0	0	+	+		......	......	0	0	0	0	0	......
	......	1.45	15	......	......	......	5.94	560	40	190	10	......	0	0	0	+		......	......	0	0	0	0	0	......
	......	2.15	16	......	......	......	6.17	260	140	60	10	......	0	0	0	+		......	......	0	0	0	0		......
	......	2.45	17	......	......	......	6.04	150	20	60	50	......	0	0	0	+		......	......	0	0	0	0		......
	......	3.15	18	......	......	......	7.38	1,100	40	160	0	......	0	+	+	+		......	......	0	0	0			......
March 10	8.37	......	(start)	Stopped cleaning filter.																					
	8.37	......	1	0.75	0	0	......	......	0	......	0	......	......	......	......	......	......	......	......	0	0	9	0	0	......
	8.38	......	2	......	......	......	4.13	......	70	......	30	......	......	......	......	......	......	......	......	0	0	0	0	0	......
	8.40	......	3	......	......	......	4.10	1,400	30	180	10	......	0					......	......	0	0	0	0		......
	8.42	......	4	......	......	......	4.06	......	30	......	10	......	......	......	......	......	......	......	......	0	0				......
	8.44	......	5	......	......	......	4.10	......	170	......	0	......	......	......	......	......	......	......	......	0	0	0	0		......
	8.46	......	6	......	......	......	4.13	......	110	......	10	......	......	......	......	......	......	......	......	0	0	0			......
	8.48	......	7	......	......	......	4.15	480	40	40	20	......	0	0				......	......	0	0				......
	8.50	......	8	......	......	......	4.17	......	30	......	0	......	......	......	......	......	......	......	......	0	0				......
	9.00	......	9	......	......	......	4.17	650	30	40	0	......	0	0	+	+	+	......	......	0	0				......
	9.30	......	10	......	......	......	4.15	890	20	40	10	......	0	0	+			......	......	0	+				......
	10.00	......	11	......	......	......	4.21	1,450	20	160	40	......	0	+				......	......	0	0				......
	10.30	......	12	......	......	......	4.00	1,100	30	110	10	......	0	+				......	......	0	0	0			......
	11.00	......	13	......	......	......	4.50	440	20	60	10	......	0	+				......	......	0	0	0			......
March 11	9.46	......	(start)	Stopped cleaning filter																					
	9.46	......	1	0.75	0	0	......	......	30	......	20	......	......	......	......	......	......	......	......	0	0	0	0		......
	9.48	......	2	......	......	......	3.71	......	280	......	10	......	......	......	......	......	......	......	......	0	0	0			......
	9.50	......	3	......	......	......	3.73	850	170	1,800	20	......	0					......	......	0	0				......
	9.52	......	4	......	......	......	3.69	......	120	......	170	......	......	......	......	......	......	......	......	0	0	0			......
	0.54	......	5	......	......	......	4.06	......	220	......	10	......	......	......	......	......	......	......	......	0	0	0			......
	9.56	......	6	......	......	......	4.00	......	180	......	110	......	......	......	......	......	......	......	......	0	0				......
	9.58	......	7	......	......	......	4.04	650	110	1,200	60	......	0					......	......	0	0				......
	0.00	......	8	......	......	......	4.02	......	140	......	140	......	......	......	......	......	......	......	......	0					......
	10.20	......	9	......	......	......	3.96	4,200	60	720	180	......	0	+	+	+	......	......	......	0					......
	10.40	......	10	......	......	......	4.04	4,800	600	1,400	90	......	+	+	+		......	......	......	0		+			......
	11.00	......	11	......	......	......	4.10	8,000	430	1,800	40	......	0	+	+		......	......	......	0	0	+			......
	11.20	......	12	......	......	......	4.15	4,800	600	1,700	120	......	+	+	+		......	......	......	0	0		+		......
	11.40	......	13	......	......	......	4.17	5,200	210	1,650	10	......	+	+	+		......	......	......	0	0	+	+	+	......
	12.00	......	14	......	......	......	4.21	4,200	480	1,400	20	......	+	+	+		......	......	......	0	0		+	+	......
	......	12.20	15	......	......	......	4.27	4,400	360	1,650	0	......	0	+	+	+	......	......	......	0	0		+	+	......
	......	12.40	16	......	......	......	4.31	7,200	410	1,100	20	......	+	+	+	+	......	......	......	0	+	+	+	+	......
	......	1.00	17	......	......	......	4.35	4,200	410	1,850	50	......	0	+	+	+	......	......	......	0	0				......
	......	1.20	18	......	......	......	4.40	5,700	300	1,800	50	......	0	+	+	+	......	......	......	0					......

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
March 11	......	1.40	19	......	......	......	4.44	12,800	110	1,950	60	......	0	0	+	+	......	......	......	0	0	+	+	+	......
	......	2.00	20	......	......	......	4.50	11,400	90	2,100	80	......	0	0	+	+	......	......	......	0	0	+	0	+	......
	......	2.20	21	......	......	......	4.54	5,200	300	1,400	70	......	0	0	+	+	......	......	......	0	0	+	0	+	......
	......	2.40	22	......	......	......	4.60	5,600	390	1,450	10	......	0	0	+	+	......	......	......	0	0	+	0	+	......
	......	3.00	23	......	......	......	4.67	3,800	330	1,150	50	......	0	0	+	+	......	......	......	0	0	0	0	+	......
March 12	8.31	......	......	Stopped cleaning filter.																					
	8.31	......	1 (start)	0.95	0	0	......	......	0	......	40	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	8.32	......	2	......	......	......	4.48	......	10	......	30	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	8.54	......	3	......	......	......	4.44	950	90	1,800	150	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	8.36	......	4	......	......	......	4.35	......	150	......	220	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	8.38	......	5	......	......	......	4.35	......	110	......	120	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	8.40	......	6	......	......	......	4.42	......	190	......	140	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	8.42	......	7	......	......	......	4.13	920	50	2,400	160	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	8.44	......	8	......	......	......	4.15	......	10	......	70	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.00	......	9	......	......	......	4.17	850	20	1,100	20	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	9.30	......	10	......	......	......	4.19	900	20	1,200	40	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	9.40	......	11	......	......	......	4.21	950	0	950	0	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	10.00	......	12	......	......	......	4.29	780	40	720	40	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	10.20	......	13	......	......	......	4.29	420	20	650	0	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	10.40	......	14	......	......	......	4.38	900	30	900	0	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	11.00	......	15	......	......	......	4.46	1,200	10	190	0	......	0	+	+	+	......	......	......	0	+	0	+	+	......
	11.20	......	16	......	......	......	4.18	1,600	20	130	30	......	+	+	+	+	......	......	......	0	+	0	+	+	......
	11.40	......	17	......	......	......	4.58	650	20	420	20	......	+	+	+	+	......	......	......	0	+	0	+	+	......
	12.00	......	18	......	......	......	4.67	620	0	280	0	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	......	12.30	19	......	......	......	4.71	560	30	180	0	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	......	12.40	20	......	......	......	4.85	720	20	370	0	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	......	1.00	21	......	......	......	4.92	430	10	90	0	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	......	1.20	22	......	......	......	5.02	410	20	80	0	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	......	1.40	23	......	......	......	5.06	30	0	80	0	......	0	+	+	+	......	......	......	0	0	0	+	+	......
March 13	9.51			Stopped cleaning filter.																					
	9.54	......	1 (start)	0.75	0	0	......	......	40	......	0	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.55	......	2	......	......	......	4.00	......	510	......	0	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.57	......	3	......	......	......	4.00	15,200	1,200	2,800	60	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	9.59	......	4	......	......	......	4.00	......	1,400	......	50	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	10.01	......	5	......	......	......	4.04	......	730	......	60	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	10.03	......	6	......	......	......	4.08	......	520	......	50	......	......	......	......	......	......	......	......	+	+	+	+	+	......
	10.05	......	7	......	......	......	4.10	3,200	450	700	20	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	10.07	......	8	......	......	......	4.13	......	240	......	70	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	10.20	......	9	......	......	......	4.19	1,200	30	40	10	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.40	......	10	......	......	......	4.29	570	60	60	10	......	0	0	+	+	+	......	......	0	0	+	0	+	......
	11.00	......	11	......	......	......	4.35	440	30	10	0	......	0	0	0	+	+	......	......	0	0	0	0	+	......
	11.20	......	12	......	......	......	4.40	260	30	70	30	......	0	0	0	+	+	......	......	0	0	+	+	+	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction; + = positive reaction. Influent.							Effluent.						
								18°-22° C		37° C															
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
March 15, 1911......	11.40	......	13	......	......	......	4.44	380	0	0	0	......	0	0	0	+	+	......	......	0	0	0	+	+	......
	12.00	......	14	......	......	......	4.48	170	420	10	110	......	0	0	0	0	+	......	......	0	0	+	+	+	......
	......	12.20	15	......	......	......	4.88	780	70	30	20	......	0	0	0	+	+	......	......	0	0	0	+	+	......
	......	12.40	16	......	......	......	4.90	2,900	190	340	0	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	......	1.00	17	......	......	......	4.90	2,800	80	420	20	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	1.20	18	......	......	......	5.00	3,100	10	650	70	......	0	0	+	+	+	......	......	0	+	+	+	+	......
March 17	......	......	....	Stirrer of stock coagulant stopped during the night																					
	9.24	......	....	Stopped cleaning the filter.																					
	9.24	......	1 (start)	......	0.75	0	0	......	60	......	6	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	9.25	......	2	......	......	......	4.88	......	80	......	30	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.27	......	3	......	......	......	4.77	5,200	690	2,600	30	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	9.29	......	4	......	......	......	4.81	......	620	......	100	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.31	......	5	......	......	......	4.73	......	950	......	70	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.33	......	6	......	......	......	4.79	......	280	......	20	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.35	......	7	......	......	......	4.81	2,400	330	950	30	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	9.37	......	8	......	......	......	4.79	......	250	......	30	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.45	......	9	......	......	......	4.85	3,200	720	450	70	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	10.00	......	10	......	......	......	4.77	3,600	200	950	120	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	10.20	......	11	......	......	......	4.94	3,600	220	1,100	80	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	10.40	......	12	......	......	......	5.02	3,400	50	650	110	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	11.00	......	13	......	......	......	5.10	3,600	140	2,800	70	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	11.20	......	14	......	......	......	5.17	4,800	140	1,600	90	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	11.40	......	15	......	......	......	5.21	4,400	310	2,600	80	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	12.00	......	16	......	......	......	5.27	4,200	210	1,800	100	......	+	+	+	+	+	......	......	+	0	+	+	+	......
	......	12.20	17	......	......	......	5.31	4,600	90	1,600	80	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	12.40	18	......	......	......	5.35	4,200	110	1,800	100	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	......	1.00	19	......	......	......	5.38	5,200	40	2,100	50	......	+	+	+	+	+	......	......	+	+	+	+	+	......
	......	1.20	20	......	......	......	5.31	4,800	80	1,800	20	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	1.40	21	......	......	......	5.40	4,600	140	1,400	40	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	......	2.00	22	......	......	......	5.48	5,200	90	1,100	30	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	......	2.20	23	......	......	......	5.50	4,600	220	1,600	30	......	+	+	+	+	+	......	......	+	+	+	+	+	......
March 18	......	......	....	Stirrer of stock coagulant stopped during the night.																					
	9.36	......	(start)	Stopped cleaning filter.																					
	9.36	......	1	0.75	0	0	......	......	10	......	0	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.37	......	2	......	......	......	4.77	......	50	......	110	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.39	......	3	......	......	......	4.46	1,200	150	1,600	210	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	9.41	......	4	......	......	......	4.38	......	140	......	260	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.43	......	5	......	......	......	4.33	......	170	......	150	......	......	......	......	......	......	......	......	+	+	+	+	+	......
	9.45	......	6	......	......	......	4.29	......	120	......	150	......	......	......	......	......	......	......	......	0	+	+	+	+	......

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

Date.	Hour. A.M.	Hour. P.M.	Serial No.	Grains of Chemicals added per U.S. gallon. Alum.	Soda Ash.	Lime.	Max. loss of Head.	Bacterial Counts. 18°–22° C Inf.	18°–22° C Eff.	37° C Inf.	37° C Eff.	Colon Bacilli. 0 = negative reaction, + = positive reaction. Influent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	Effluent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 March 18	9.47	......	7	......	......	......	4.33	950	220	2,200	330	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	9.49	......	8	......	......	......	4.31	......	90	......	90	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	10.00	......	9	......	......	......	4.40	1,200	70	1,100	10	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	10.20	......	10	......	......	......	4.42	950	100	850	80	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	10.40	......	11	......	......	......	4.46	800	20	800	60	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	11.00	......	12	......	......	......	4.50	1,400	20	950	0	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	11.20	......	13	......	......	......	4.52	950	10	700	40	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	11.40	......	14	......	......	......	4.56	3,200	20	700	70	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	12.00	......	15	......	......	......	4.60	2,800	40	1,200	0	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	......	12.20	16	......	......	......	4.63	850	20	700	20	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	......	12.40	17	......	......	......	4.69	1,400	20	1,100	20	......	0	0	+	+	......	......	......	0	0	+	+	+	......
	......	1.00	18	......	......	......	4.73	1,200	0	1,200	20	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	......	1.20	19	......	......	......	4.85	1,400	20	850	20	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	......	1.40	20	......	......	......	4.85	1,650	80	550	0	......	+	+	+	+	......	......	......	0	0	0	+	+	......
	......	2.00	21	......	......	......	4.92	1,200	30	300	10	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	......	2.20	22	......	......	......	5.02	950	0	420	10	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	......	2.40	23	......	......	......	5.08	1,000	10	530	10	......	8	+	+	+	......	......	......	0	0	+	+	+	......
March 19			Stirrer for stock coagulants stopped during the night.																						
	9.26	......	(start)	Stopped cleaning filter.																					
	9.26	......	1	0.75	0	0	......	......	60	......	10	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	9.27	......	2	......	......	......	4.31	......	110	......	60	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.29	......	3	......	......	......	4.29	12,200	770	2,600	290	......	+	+	+	+	+	......	......	+	+	+	+	+	......
	9.31	......	4	......	......	......	4.31	......	2,200	......	320	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.33	......	5	......	......	......	4.38	......	2,200	......	90	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.35	......	6	......	......	......	4.40	......	650	......	280	......	......	......	......	......	......	......	......	0	+	+	+	+	......
	9.37	......	7	......	......	......	4.42	8,600	1,100	1,800	60	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	9.39	......	8	......	......	......	4.44	......	490	......	30	......	......	......	......	......	......	......	......	0	0	+	+	+	......
	9.45	......	9	......	......	......	4.44	6,800	1,100	1,100	10	......	+	+	+	+	......	......	......	0	+	+	+	+	......
	10.00	......	10	......	......	......	4.65	6,800	520	1,200	40	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	10.20	......	11	......	......	......	4.73	3,600	440	730	10	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	10.40	......	12	......	......	......	4.73	2,500	340	750	20	......	+	+	+	+	......	......	......	0	0	0	+	+	......
	11.00	......	13	......	......	......	4.81	3,200	100	950	50	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	11.20	......	14	......	......	......	4.92	2,600	130	390	0	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	11.40	......	15	......	......	......	4.90	2,800	130	540	180	......	0	+	+	+	......	......	......	+	+	+	+	+	......
	12.00	......	16	......	......	......	4.94	2,400	90	670	60	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	......	12.20	17	......	......	......	4.98	2,200	140	530	60	......	0	+	+	+	......	......	......	0	+	+	+	+	......
	......	12.40	18	......	......	......	5.02	2,800	90	650	40	......	0	+	+	+	......	......	......	0	+	+	+	+	......
March 24	9.31	......	(start)	Stopped cleaning filter.																					
	9.31	......	1	0.75	0	0	......	......	70	......	40	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	9.32	......	2	......	......	......	4.15	......	60	......	20	......	......	......	......	......	......	......	......	0	0	0	0	+	......
	9.34	......	3	......	......	......	4.17	900	30	700	80	0	0	+	+	+	+	......	......	0	0	0	+	+	......
	9.36	......	4	......	......	......	4.25	......	50	......	70	......	......	......	......	......	......	......	......	0	0	0	+	+	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour. A.M.	Hour. P.M.	Serial No.	Grains of Chemicals added per U.S. gallon. Alum.	Soda Ash.	Lime.	Max. loss of Head.	Bacterial Counts. 18°-22° C Inf.	18°-22° C Eff.	37° C Inf.	37° C Eff.	Colon Bacilli. 0 = negative reaction, + = positive reaction. Influent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	Effluent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 March 24	9.38	......	5	......	......	......	4.25	......	160	......	40	......	......	......	......	......	......	......	......	0	0	0	+	+	......
	9.40	......	6	......	......	......	4.25	......	60	......	40	......	......	......	......	......	......	......	......	0	0	0	+		......
	9.42	......	7	......	......	......	4.27	600	70	200	10	0	0	+	+	+	+	......	......	0	0	0	0		......
	9.44	......	8	......	......	......	4.29	......	80	......	70	......	......	......	......	......	......	......	......	0	0	0	0		......
	9.50	......	9	......	......	......	4.23	400	200	100	200	0	0	+		+	......	......	0	0	0	+	+	......	......
	10.00	......	10	......	......	......	4.44	400	500	300	200	0	0	0	0	+	......	......	0	0	0	0	+	......	......
	10.20	......	11	......	......	......	4.48	4,300	300	1,600	0	0	+	+	+	+	......	......	0	0	0	0	0	......	......
	10.40	......	12	......	......	......	4.60	9,500	500	4,900	300	0	+	+	+	+	......	......	0	0	0	+	+	......	......
	11.00	......	13	......	......	......	4.75	6,500	0	11,000	100	+	+	+	+	+	......	......	0	0	0	+	+	......	......
	11.20	......	14	......	......	......	4.88	12,000	0	6,300	100	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	11.40	......	15	......	......	......	5.00	11,000	100	13,000	300	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	12.00	......	16	......	......	......	5.10	9,500	0	12,000	0	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	......	12.20	17	......	......	......	5.21	6,500	0	11,000	400	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	......	12.40	18	......	......	......	5.33	7,000	0	12,000	300	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	1.00	19	......	......	......	5.58	12,000	1,100	8,300	700	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	1.20	20	......	......	......	5.63	18,000	1,000	8,500	400		+	+	+	+	......	......	0	0	+	+	+	......	......
	......	1.40	21	......	......	......	5.67	11,000	1,100	11,000	600		+	+	+	+	......	......	0	0	+	+	+	......	......
	......	2.00	22	......	......	......	5.79	12,000	800	8,600	200		+	+	+	+	......	......	0	+	+	+	+	......	......
	......	2.30	23	......	......	......	5.85	8,500	400	8,500	600	+	+	+	+	+	......	......	0	+	+	+	+	......	......
				Note.—As the filter had stopped overflowing an increased amount of coagulant was present in the storage tank.																					
March 25	9.28	......	(start)	Started after cleaning for 10 mins																					
	9.28	......	1	0.75	0	0	......	......	1,200	......	300	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	9.29	......	2	......	......	......	4.15	......	2,400	......	1,100	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	9.31	......	3	......	......	......	4.13	124000	24,000	42,000	4,200	+		+	+	+	......	......	0	+	+	+	+	......	......
	9.33	......	4	......	......	......	4.08	......	8,500	......	11,500	......	......	......	......	......	......	......		+	+	+	+	......	......
	9.35	......	5	......	......	......	4.25	......	13,000	......	4,500	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	9.37	......	6	......	......	......	4.19	......	21,000	......	4,900	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	9.39	......	7	......	......	......	4.21	160000	18,000	88,000	6,900	+	+	+	+	+	......	......	0	0	+	+	+	......	......
	9.41	......	8	......	......	......	4.23	......	2,200	......	400	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	9.45	......	9	......	......	......	4.27	86,000	6,200	32,000	3,700	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	9.50	......	10	......	......	......	4.15	48,000	8,500	29,000	4,000	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	10.00	......	11	......	......	......	4.40	42,000	1,400	26,000	2,200	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	10.20	......	12	......	......	......	4.40	72,000	4,400	29,000	2,800	0	+	+	+	+	......	......	+	+	+	+	+	......	......
	10.40	......	13	......	......	......	4.46	54,000	5,600	18,000	3,300	0	+	+	+	+	......	......	+	0	+	+	+	......	......
	11.00	......	14	......	......	......	4.48	42,000	5,700	19,000	2,000	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	11.20	......	15	......	......	......	4.50	48,000	6,500	22,000	3,100	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	11.40	......	16	......	......	......	4.50	44,000	7,000	21,000	5,200	+	+	+	+	+	......	......	0	+	+	+	+	......	......

The Rapid Sand-Mechanical Gravity Filter.

OPERATING DATA

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0=negative reaction +=positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
March 25	12.00	......	17	......	......	......	4.52	36,000	11,000	11,000	3,300	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	12.20	18	......	......	......	4.54	19,000	7,200	6,500	2,800	+	+	+	+	+	......	......	+	0	+	+	+	......	......
	......	12.40	19	......	......	......	4.58	42,000	3,100	12,000	1,200	0	+	+	+	+	......	......	+	+	+	+	+	......	......
	......	1.00	20	......	......	......	4.60	48,000	6,500	14,000	1,100	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	1.20	21	......	......	......	4.63	44,000	3,800	9,500	900	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	1.40	22	......	......	......	4.67	23,000	3,900	9,000	1,900	0	0	+	+	+	......	......	0	0	+	+	+	......	......
	......	2.00	23	......	......	......	4.71	52,000	4,100	11,000	500	0	+	+	+	+	......	......	0	0	+	+	+	......	......
March 26	9.20	......	1	0.75	0	0	6.48	6,700	1,100	9,500	1,400	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	10.02	......	(start)	Started after washing filter for 8 mins.																					
	10.02	......	2	0.75	0	0	......	......	400	......	0	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	10.03	......	3	......	......	......	4.21	......	3,600	......	3,100	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	10.05	......	4	......	......	......	4.23	82,000	6,000	122000	8,500	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	10.07	......	5	......	......	......	4.31	......	8,500	......	7,500	......	......	......	......	......	......	......	+	+	+	+	+	......	......
	10.09	......	6	......	......	......	4.33	......	14,000	......	26,000	......	......	......	......	......	......	......	+	+	+	+	+	......	......
	10.11	......	7	......	......	......	4.33	......	7,300	......	5,500	......	......	......	......	......	......	......	+	+	+	+	+	......	......
	10.13	......	8	......	......	......	4.35	48,000	4,000	48,000	6,100	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	10.15	......	9	......	......	......	4.31	......	1,000	......	1,800	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	10.20	......	10	......	......	......	4.31	5,500	2,100	9,500	4,400	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	10.40	......	11	......	......	......	4.42	20,000	1,000	4,300	1,800	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	11.00	......	12	......	......	......	4.50	11,000	400	4,800	1,100	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	11.20	......	13	......	......	......	4.52	11,000	500	9,500	1,100	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	11.40	......	14	......	......	......	4.54	7,300	800	9,000	1,000	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	12.00	......	15	......	......	......	4.56	14,000	1,800	7,500	1,600	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	12.20	16	......	......	......	4.63	14,000	1,600	5,500	2,000	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	12.40	17	......	......	......	4.67	4,500	500	6,100	2,100	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	......	1.00	18	......	......	......	4.69	6,200	600	5,700	1,200	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	1.20	19	......	......	......	4.77	5,600	800	4,800	700	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	1.40	10	......	......	......	4.83	11,000	100	8,500	300	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	2.00	21	......	......	......	4.90	12,000	500	8,100	400	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	2.20	22	......	......	......	4.96	9,500	100	6,400	300	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	2.40	23	......	......	......	5.00	9,000	100	8,500	600	+	+	+	+	+	......	......	0	0	+	+	+	......	......
March 27	9.20	......	1	0.75	0	0	7.50	56,000	8,800	1,8,0	1,100	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	9.32	......	(start)	Started filter after washing for 9½ mins																					
	9.32	......	2	0.75	0	0	......	......	1,600	......	600	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	9.33	......	3	......	......	......	4.42	......	8,500	......	1,400	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	9.35	......	4	......	......	......	4.42	7,200	11,000	32,000	6,000	+	+	+	+	+	......	......	+	+	+	+	+	......	......
	9.37	......	5	......	......	......	4.31	......	7,300	......	7,500	......	......	......	......	......	......	......	+	+	+	+	+	......	......
	9.39	......	6	......	......	......	4.29	......	9,000	......	9,000	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	9.41	......	7	......	......	......	4.40	......	7,600	......	3,800	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	9.43	......	8	......	......	......	4.40	84,000	12,000	12,000	5,200	+	+	+	+	+	......	......	+	+	+	+	+	......	......
	9.45	......	9	......	......	......	4.40	......	10,000	......	4,500	......	......	......	......	......	......	......	+	+	+	+	+	......	......
	9.50	......	10	......	......	......	4.40	48,000	19,000	7,800	3,000	+	+	+	+	+	......	......	+	+	+	+	+	......	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 March 20	10.00	......	11	......	......	......	4.40	38,000	5,400	4,500	800	+	+	+	+	+	......	......	+	+	+	+	+	......	......
	10.20	......	12	......	......	......	4.38	42,000	5,800	4,500	800	0	+	+	+	+	......	......	+	+	+	+	+	......	......
	10.40	......	13	......	......	......	4.48	14,000	5,700	8,300	500	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	11.00	......	14	......	......	......	4.48	14,000	6,700	1,400	900	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	11.20	......	15	......	......	......	4.50	14,000	3,100	2,200	300	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	11.40	......	16	......	......	......	4.50	20,000	5,100	1,200	1,000	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	12.00	......	17	......	......	......	4.54	21,000	5,300	2,100	2,700	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	12.20	18	......	......	......	4.60	19,000	4,600	3,400	1,300	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	12.40	19	......	......	......	4.58	12,000	3,800	1,600	1.300	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	1.00	20	......	......	......	4.60	19,500	2,600	3,100	100	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	1.20	21	......	......	......	4.60	14.000	5,400	4,200	500	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	1.40	22	......	......	......	4.67	21,000	2,800	900	300	+	+	+	+	+	......	......	0	0	+	+	+	......	......
	......	2.00	23	......	......	......	4.75	58,000	1.400	2,600	600	0	+	+	+	+	......	......	0	+	+	+	+	......	......
March 31	9.26	......	(start)	Started after washing filter for 13 mins.																					
	9.26	......	1	1.5	0	0	......	......	300	......	100	......	......	......	......	......	......	......	0	0	0	+	......	......	......
	9.27	......	2	......	......	......	4.00	......	2,700	......	200	......	......	......	......	......	......	......	0	0	0	+	......	......	......
	9.29	......	3	......	......	......	3.98	126000	18,000	16,000	800	0	+	+	+	......	......	......	+	+	+	+	......	......	......
	9.31	......	4	......	......	......	4.13	......	46,000	......	1,100	......	......	......	......	......	......	......	0	+	+	+	......	......	......
	9.33	......	5	......	......	......	4.21	......	38,000	......	2,600	......	......	......	......	......	......	......	0	+	+	+	......	......	......
	9.35	......	6	......	......	......	4.17	......	24,000	......	300	......	......	......	......	......	......	......	0	+	+	+	......	......	......
	9.37	......	7	......	......	......	4.19	42,000	21,000	6,400	700	+	+	+	+	......	......	......	0	+	+	+	......	......	......
	9.39	......	8	......	......	......	4.17	......	11,000	......	600	......	......	......	......	......	......	......	+	+	+	+	......	......	......
	9.44	......	9	......	......	......	4.17	12,000	15,000	7,400	300	+	+	+	+	......	......	......	0	+	+	+	......	......	......
	9.50	......	10	......	......	......	4.23	24,000	6,600	4,900	200	0	+	+	+	......	......	......	0	+	+	+	......	......	......
	10.00	......	11	......	......	......	4.25	12,000	2,800	3,700	700	0	+	+	+	......	......	......	0	+	+	+	......	......	......
	10.20	......	12	......	......	......	4.29	18,000	1,500	4,200	1,200	0	+	+	+	......	......	......	+	+	+	+	......	......	......
	10.40	......	13	......	......	......	4.33	12,000	1,000	9,500	200	0	+	+	+	......	......	......	0	0	+	+	......	......	......
	11.00	......	14	......	......	......	4.40	18,000	800	3,800	500	0	+	+	+	......	......	......	0	+	+	+	......	......	......
	11.20	......	15	......	......	......	4.44	14,000	600	5,700	0	+	+	+	+	......	......	......	+	+	+	+	......	......	......
	11.40	......	16	......	......	......	4.54	11,000	800	8,400	600	+	+	+	+	......	......	......	0	+	+	+	......	......	......
	12.00	......	17	......	......	......	4.54	14,000	500	8,500	200	+	+	+	+	......	......	......	0	0	+	+	......	......	......
	......	12.00	18	......	......	......	4.77	11,000	700	8,700	200	+	+	+	+	......	......	......	0	+	+	+	......	......	......
April 1	9.40	......	(start)	Started after washing filter for 12½ mins.																					
	9.40	......	1	1.5	0	0	......	......	200	......	100	......	......	......	......	......	......	......	0	0	0	+	......	......	......
	9.41	......	2	......	......	......	4.42	......	13,000	......	1,400	......	......	......	......	......	......	......	0	0	0	+	......	......	......
	9.43	......	3	......	......	......	4.38	144000	56,000	23,000	3,400	+	+	+	+	......	......	......	0	+	+	+	......	......	......
	9.45	......	4	......	......	......	4.23	......	48,000	......	2.300	......	......	......	......	......	......	......	0	+	+	+	......	......	......
	9.47	......	5	......	......	......	4.44	......	24,000	......	2,500	......	......	......	......	......	......	......	+	+	+	+	......	......	......

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0=negative reaction +=positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
April 1	9.49	......	6	......	......	......	4.44	......	22,000	......	2,300	......	......	......	......	......	......	......	0	+	+	+	......	......	......
	9.51	......	7	......	......	......	4.38	120000	24,000	11,000	4,200	+	+	+	+	......	......	......	0	+	+	+	......	......	......
	9.53	......	8	......	......	......	4.44	......	20,000	......	2,300	......	......	......	......	......	......	......	+	+	+	+	......	......	......
	9.58	......	9	......	......	......	4.40	88,000	14,000	6,000	1,500	+	+	+	+	......	......	......	0	0	+	+	......	......	......
	10.05	......	10	......	......	......	4.48	36,000	9,500	6,500	500	0	+	+	+	......	......	......	+	0	+	+	......	......	......
	10.20	......	11	......	......	......	4.50	26,000	9,000	4,800	600	0	+	+	+	......	......	......	0	+	+	+	......	......	......
	10.40	......	12	......	......	......	4.54	42,000	3,000	6,500	300	0	+	+	+	......	......	......	0	+	+	+	......	......	......
	11.00	......	13	......	......	......	4.56	40,000	2,600	8,200	600	+	+	+	+	......	......	......	+	+	+	+	......	......	......
	11.20	......	14	......	......	......	4.63	38,000	3,300	5,500	1,000	0	+	+	+	......	......	......	0	+	+	+	......	......	......
	11.40	......	15	......	......	......	4.67	38,000	2,700	5,000	700	0	+	+	+	......	......	......	0	+	+	+	......	......	......
	12.00	......	16	......	......	......	4.71	36,000	1,600	5,400	400	+	+	+	+	......	......	......	0	0	+	+	......	......	......
	......	12.20	17	......	......	......	4.79	32,000	2,300	6,700	900	+	+	+	+	......	......	......	0	+	+	+	......	......	......
	......	12.40	18	......	......	......	4.85	34,000	2,300	10,500	400	0	+	+	+	......	......	......	0	0	+	+	......	......	......
	......	1.00	19	......	......	......	4.94	28,000	700	8,400	800	+	+	+	+	......	......	......	0	0	+	+	......	......	......
	......	1.20	20	......	......	......	5.06	32,000	1,700	9,000	200	+	+	+	+	......	......	......	0	+	0	+	......	......	......
	......	1.40	21	......	......	......	5.17	32,000	1,900	5,800	200	0	+	+	+	......	......	......	0	0	+	+	......	......	......
	......	2.00	22	......	......	......	5.23	25,000	1,100	9,500	300	0	+	+	+	......	......	......	0	0	0	+	......	......	......
	......	2.20	23	......	......	......	5.23	26,000	2,200	5,300	0	0	+	+	+	......	......	......	0	0	+	+	......	......	......
April 2	9.44	......	(start)	Started after washing for 13 mins.																					
	9.44	......	1	1.5	0	0	......	......	300	......	300	......	......	......	......	......	......	......	0	0	0	+	......	......	......
	9.45	......	2	......	......	......	4.60	......	1,100	......	400	......	......	......	......	......	......	......	0	0	0	+	......	......	......
	9.47	......	3	......	......	......	4.56	24,000	5,500	22,000	2,400	+	+	+	+	......	......	......	0	0	+	+	......	......	......
	9.49	......	4	......	......	......	4.58	......	0	......	2,500	......	......	......	......	......	......	......	0	+	+	+	......	......	......
	9.51	......	5	......	......	......	4.65	......	9,500	......	1,400	......	......	......	......	......	......	......	+	+	+	+	......	......	......
	9.53	......	6	......	......	......	4.71	......	6,200	......	1,200	......	......	......	......	......	......	......	0	+	+	+	......	......	......
	9.55	......	7	......	......	......	4.63	6,600	1,800	11,000	5,200	+	+	+	+	......	......	......	+	+	+	+	......	......	......
	9.57	......	8	......	......	......	4.73	......	200	......	1,000	......	......	......	......	......	......	......	0	0	+	+	......	......	......
	10.02	......	9	......	......	......	4.69	13,000	1,100	3,700	1,100	0	+	+	+	......	......	......	+	0	+	+	......	......	......
	10.10	......	10	......	......	......	4.94	5,300	900	2,600	400	+	0	+	+	......	......	......	0	0	0	+	......	......	......
	10.20	......	11	......	......	......	4.94	16,000	200	2,200	200	0	+	+	+	......	......	......	0	0	0	+	......	......	......
	10.40	......	12	......	......	......	5.08	13,000	200	4,800	700	0	+	+	+	......	......	......	0	0	0	0	......	......	......
	11..0	......	13	......	......	......	5.19	8,200	0	2,600	0	0	+	+	+	......	......	......	0	0	0	+	......	......	......
	11.00	......	14	......	......	......	5.38	14,000	100	6,300	0	+	+	+	+	......	......	......	0	0	0	+	......	......	......
	11.00	......	15	......	......	......	5.44	11,000	0	5,600	100	0	+	+	+	......	......	......	0	0	0	+	......	......	......
	12.00	......	16	......	......	......	5.56	9,500	600	6,700	200	0	+	+	+	......	......	......	0	0	0	+	......	......	......
	......	12.00	17	......	......	......	5.69	10,500	100	4,800	0	0	+	+	+	......	......	......	0	0	+	+	......	......	......
	......	12.00	18	......	......	......	5.77	4,500	100	2,200	0	0	0	+	+	......	......	......	0	0	0	+	......	......	......
	......	1.00	19	......	......	......	5.92	12,000	600	3,700	100	0	+	+	+	......	......	......	0	0	+	+	......	......	......
	......	1.00	20	......	......	......	6.08	9,500	900	3,900	200	0	+	+	+	......	......	......	0	0	0	+	......	......	......
	......	1.00	21	......	......	......	6.21	6,300	500	3,100	0	0	+	+	+	......	......	......	0	0	0	+	......	......	......
	......	2.00	22	......	......	......	6.29	6,200	100	3,500	200	0	+	+	+	......	......	......	0	0	0	+	......	......	......
	......	2.00	23	......	......	......	6.42	800	300	1,800	0	+	+	+	+	......	......	......	0	0	0	+	......	......	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction, + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 April 7	9.21	......	(start)	Started after washing filter for 11½ mins.																					
	9.21	......	1	1.5	0	0	......	......	600	......	700	......	......	......	......	......	......	......	0	0	0	0	......	......	......
	9.22	......	2	......	......	......	......	......	600	......	200	......	......	......	......	......	......	......	0	+	0	+	......	......	......
	9.24	......	3	......	......	......	4.21	88,000	1,400	24,000	800	0	0			......	......	......	0	0	0	+	......	......	......
	9.26	......	4	......	......	......	4.31	......	2,700	......	300	......	......	......	......	......	......	......	0	0	+	+	......	......	......
	9.28	......	5	......	......	......	4.40	......	8,600	......	1,300	......	......	......	......	......	......	......	0	0	0	+	......	......	......
	9.30	......	6	......	......	......	4.46	......	2,600	......	600	......	......	......	......	......	......	......	0	0	+	+	......	......	......
	9.32	......	7	......	......	......	4.52	22,000	1,700	6,000	1,400	0				......	......	......	0	0	0	+	......	......	......
	9.34	......	8	......	......	......	4.63	......	600	......	100	......	......	......	......	......	......	......	0	+	0	+	......	......	......
	9.39	......	9	......	......	......	4.65	16,000	1,800	6,800	0	0	0	+		......	......	......	0	0	0	+	......	......	......
	9.49	......	10	......	......	......	4.79	12,000	2,800	12,500	100	0		+		......	......	......	0	0	0	+	......	......	......
	10.00	......	11	......	......	......	4.90	11,000	3,100	7,000	100	0		+		......	......	......	0	0	0	0	......	......	......
	10.20	......	12	......	......	......	4.96	9,000	500	8,200	0	0		+		......	......	......	0	0	0	+	......	......	......
	10.40	......	13	......	......	......	5.15	8,400	400	7,800	100	0		+		......	......	......	0	0	+	+	......	......	......
	11.00	......	14	......	......	......	5.21	28,000	700	12,500	100	0		+		......	......	......	0	0	+	+	......	......	......
	11.20	......	15	......	......	......	5.33	22,000	0	10,500	600	0		+		......	......	......	0	0	+	+	......	......	......
	11.46	......	16	......	......	......	5.56	21,000	1,100	14,000	300	0		+		......	......	......	0		+	+	......	......	......
	12.00	......	17	......	......	......	5.71	24,000	0	12,500	300			+		......	......	......	0	0	+	+	......	......	......
	......	12.20	18	......	......	......	5.85	19,000	0	7,900	100	0		+		......	......	......	0	+	0	+	......	......	......
	......	12.40	19	......	......	......	6.00	28,000	300	9,800	0			+		......	......	......	0	0	+	+	......	......	......
	......	1.00	20	......	......	......	6.13	32,000	400	9,000	100			+		......	......	......	0	0	+	+	......	......	......
	......	1.20	21	......	......	......	6.31	12,000	800	3,400	100	0		+		......	......	......	0	0	+	+	......	......	......
	......	1.40	22	......	......	......	6.44	16,000	400	7,400	600			+		......	......	......	0	0	+	+	......	......	......
	......	2.00	23	......	......	......	6.56	14,000	100	7,600	200			+		......	......	......	0	0	0	+	......	......	......
May 4	......	1.56	(start)	Started after washing filter for 15 mins.																					
	......	1.56	1	1.5	0	0	5.52	......	800	......	700	......	......	......	......	......	......	......	0		+	+		......	......
	......	1.58	2	......	......	......	5.56	......	3,600	......	800	......	......	......	......	......	......	......	0		+	+		......	......
	......	2.00	3	......	......	......	5.58	......	2,800	......	1,250	......	......	......	......	......	......	......	0		+	+		......	......
	......	2.02	4	......	......	......	5.60	530000	5,200	584000	3,600						......	......			+	+		......	......
	......	2.04	5	......	......	......	5.46	......	4,800	......	1,550	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	......	2.06	6	......	......	......	5.40	......	2,600	......	1,350	......	......	......	......	......	......	......		0	+	+		......	......
	......	2.08	7	......	......	......	5.29	530000	4,000	496000	1,700						......	......	0		+	+	+	......	......
	......	2.10	8	......	......	......	5.29	......	4,400	......	3,300	......	......	......	......	......	......	......			+	+		......	......
	......	2.40	9	......	......	......	5.54	128000	34,000	44,000	13,000				+		......	......	0		+	+	+	......	......
	......	3.16	10	......	......	......	5.54	176000	48,000	76,000	21,000		+		+	+	......	......	0	+	+	+	+	......	......
	......	3.40	11	......	......	......	5.58	126000	56,000	88,000	28,000		+	+	+		......	......			+	+	+	......	......
	......	4.10	12	......	......	......	5.63	126000	112000	42,000	2,600		+		+	+	......	......	0		+	+	+	......	......
	......	4.40	13	......	......	......	5.65	108000	36,000	72,000	12,500	+	+	+	+	+	......	......	0	0	+	+	+	......	......

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1911																									
May 5	9.30	......	14	1.5	0	0	7.73	67	65	24	170	......	0	0	0	0		......	......	0	0	+	+		......
	10.00	......	15	......	......	......	7.75	110	31	60	280	......	0	0	0	0		......	......	0	0				......
May 11	......	1.26	......	Started after washing for 14 mins.																					
	......	1.31	1	1.05	0	13	5.23	128000	144000	64,000	88,000						......	......						......	......
	......	1.33	2	......	......	......	5.29	......	102000	......	44,000	......	......	......	......	......	......	......	0					......	......
	......	1.33	3	......	......	......	5.42	......	64,000	......	36,000	......	......	......	......	......	......	......		+				......	......
	......	1.35	4	......	......	......	5.35	......	96,000	......	36,000	......	......	......	......	......	......	......		+				......	......
	......	1.39	5	......	......	......	5.35	......	32,000	......	2,200	......	......	......	......	......	......	......		+				......	......
	......	1.41	6	......	......	......	5.33	......	64,000	......	17,000	......	......	......	......	......	......	......		+				......	......
	......	1.43	7	......	......	......	5.38	160000	48,000	64,000	15,000						......	......	0	+				......	......
	......	1.45	8	......	......	......	5.38	......	44,000	......	13,000	......	......	......	......	......	......	......		+				......	......
	......	2.00	9	......	......	......	5.42	76,000	12,600	14,000	6,800						......	......	......	+				......	......
	......	2.30	10	......	......	......	5.38	88,000	12,600	20,000	5,600						......	......	......	0				......	......
	......	3.00	11	......	......	......	5.38	90,000	7,200	38,000	8,000	0					......	......	......	0				......	......
	......	3.30	12	......	......	......	5.56	76,000	12,000	38,000	8,200	0					......	......	......	+				......	......
	......	4.00	13	......	......	......	5.56	82,000	9,600	32,000	7,800						......	......	......	+				......	......
May 12	9.10	......	14	1.5	0	13	7.75	7,600	800	4,800	2,800						......	......	......	+				......	......
	9.40	......	15	......	......	......	8.13	8,000	650	6,800	2,800						......	......	......	0				......	......
	......	1.20	......	Started after cleaning for 15 mins.						Used wash water for 9 mins.															
	......	1.25	1	1.5	0	13	4.73	96,000	28,000	30,000	2,400						......	......	0	+				......	......
	......	1.27	2	......	......	......	4.71	......	10,500	......	4,500	......	......	......	......	......	......	......	0	+				......	......
	......	1.29	3	......	......	......	4.67	......	11,000	......	5,000	......	......	......	......	......	......	......	0	+				......	......
	......	1.31	4	......	......	......	4.71	......	8,500	......	2,700	......	......	......	......	......	......	......		+				......	......
	......	1.33	5	......	......	......	4.69	......	21,000	......	9,500	......	......	......	......	......	......	......	0	+				......	......
	......	1.35	6	......	......	......	4.69	32,000	2,200	15,000	1,400	0					......	......	0	0				......	......
	......	1.37	7	......	......	......	4.71	......	400	......	700	......	......	......	......	......	......	......	0					......	......
	......	1.39	8	......	......	......	4.73	......	3,400	......	3,600	......	......	......	......	......	......	......						......	......
	......	1.50	9	......	......	......	4.81	21,500	9,500	40,000	5,200	0					......	......	0					......	......
	......	2.20	10	......	......	......	4.81	26,000	1,200	22,000	600	0					......	......	0					......	......
	......	2.50	11	......	......	......	4.92	21,000	900	24,000	1,800						......	......	0					......	......
	......	3.20	12	......	......	......	4.96	1,400	1,600	12,000	9,000	0					......	......	0				+	......	......
	......	3.50	13	......	......	......	5.06	1,700	0	3,200	9,000	0					......	......	0					......	......
May 13	9.10	......	14	1.5	0	13	7.73	26,000	1,400	16,000	1,000	0					......	......	0				+	......	......
	9.40	......	15	......	......	......	7.73	44,000	23,000	48,000	10,000						......	......	0	0				......	......
	10.10	......	16	......	......	......	7.73	26,000	2,400	36,000	2,800	0					......	......						......	......
	10.40	......	17	......	......	......	7.79	38,000	6,800	54,000	12,000	0					......	......	0				+	......	......
	11.10	......	18	......	......	......	8.13	14,000	4,000	32,000	6,400	0					......	......	0				+	......	......
	......	1.35		Started after washing filter for 21 mins.						Used wash water for 14 mins.															

NOTE.—A marked increase in the amount of dirt and coagulant flock given up to the wash water was noticed in to-day's cleaning of the filter. A longer washing was accordingly employed to free the filter from this extra amount of suspended matter.

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction										+ = positive reaction			
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1911 May 13	......	1.40	1	1.5	0	13	5.25	52,000	52,000	14,000	6,700						......	......	0			+	+	......	......
	......	1.42	2	......	......	......	5.27	......	32,000	......	6,600	......	......	......	......	......	......	......	0			+	+	......	......
	......	1.44	3	......	......	......	5.25	......	32,000	......	4,800	......	......	......	......	......	......	......	+			+	+	......	......
	......	1.46	4	......	......	......	5.38	......	21,000	......	7,900	......	......	......	......	......	......	......	0			+	+	......	......
	......	1.48	5	......	......	......	5.17	......	16,000	......	4,100	......	......	......	......	......	......	......	0			+	+	......	......
	......	1.50	6	......	......	......	5.21	28,000	4,300	19,000	3,200	0					......	......	0			+	+	......	......
	......	1.52	7	......	......	......	5.19	......	3,900	......	2,700	......	......	......	......	......	......	......	+			+	+	......	......
	......	1.54	8	......	......	......	5.21	......	6,800	......	2,700	......	......	......	......	......	......	......	0			+	+	......	......
	......	2.10	9	......	......	......	5.23	37,000	11,000	18,000	3,900						......	......	0			+	+	......	......
	......	2.40	10	......	......	......	5.21	24,000	5,100	13,000	1,900				+		......	......	0			+	+	......	......
	......	3.10	11	......	......	......	5.25	20,000	6,300	13,000	3,000				+		......	......	0			+	+	......	......
	......	3.40	12	......	......	......	7.90	11,000	6,000	9,000	4,800	0			+		......	......	+			+	+	......	......
May 14	11.00			NOTE.—Washed the filter for 1 hour. Much gummy coagulant and dirt was given up to the wash water. This was the best cleaning the filter had had since the coagulant was used. The addition of the lime was undoubtedly the cause.																					
	......	1.43		Started after washing filter for 14 mins. Used wash water for 12 mins.																					
	......	1.48	1	1.5	0	13	4.67	......	5,500	......	3,700	......	......	......	......	......	......	......	+				......	......	......
	......	1.50	2	......	......	......	4.79	22,000	9,500	4,100	2,200	0	0		......	......	......	......	+				......	......	......
	......	1.52	3	......	......	......	4.79	......	9,000	......	1,900	......	......	......	......	......	......	......	0	0	0		......	......	......
	......	1.54	4	......	......	......	4.79	......	9,500	......	2,200	......	......	......	......	......	......	......	0	0	+		......	......	......
	......	1.56	5	......	......	......	4.77	......	8,000	......	1,100	......	......	......	......	......	......	......	0		+		......	......	......
	......	1.58	6	......	......	......	4.77	9,500	3,500	......	200	0	0		......	......	......	......	0	0	+		......	......	......
	......	2.00	7	......	......	......	4.77	......	4,500	......	900	......	......	......	......	......	......	......	0		+		......	......	......
	......	2.02	8	......	......	......	4.77	......	4,300	......	700	......	......	......	......	......	......	......	0	0	0		......	......	......
	......	2.15	9	......	......	......	4.81	1,400	4,200	800	1,100	0				......	......	......	+		+		......	......	......
	......	2.45	10	......	......	......	4.79	1,000	1,100	6,500	1,400	0	0			......	......	......	0	0	+		......	......	......
	......	3.15	11	......	......	......	4.88	600	2,200	900	300	0				......	......	......	0		+		......	......	......
	......	3.45	12	......	......	......	4.94	400	400	1,300	100	0				......	......	......	0		+		......	......	......
May 15	......	......	......	Stirrer in coagulant tank stopped during the night.																					
	9.15	......	13	1.5	0	13	6.25	8,000	950	11,000	480	0					......	......	0	0	+			......	......
	9.45	......	14	......	......	......	6.29	9,500	1,700	11,000	1,050	0					......	......	0	0	+			......	......
	11.00	......	......	Head lost		......	8.13	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	......	1.29	......	Started after washing filter for 20 mins																					
	......	1.34	1	1.5	0	13	4.77	48,000	28,000	2,700	5,200	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	......	1.36	2	......	......	......	4.83	......	6,800	......	1,200	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	......	1.38	3	......	......	......	4.83	......	10,500	......	600	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	......	1.40	4	......	......	......	4.85	......	7,700	......	500	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	......	1.42	5	......	......	......	4.92	......	6,200	......	500	......	......	......	......	......	......	......	......	......	......	......	......	......	......

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour. A.M.	Hour. P.M.	Serial No.	Grains of Chemicals added per U.S. gallon. Alum.	Soda Ash.	Lime.	Max. loss of Head.	Bacterial Counts. 18°-22° C Inf.	18°-22° C Eff.	37° C Inf.	37° C Eff.	Colon Bacilli. 0 = negative reaction, + = positive reaction. Influent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	Effluent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 May 15		1.44	6				4.91		8,800		200														
		1.46	7				4.92		8,600		400														
		1.45	8				4.96	13,000	2,800	2,600	200														
		2.05	9				5.17	12,500	3,200	2,000	200														
		2.35	10				5.25	90,000	1,700	1,100	200														
		3.05	11				5.38	5,500	1,200	400	400														
		3.35	12				5.46	800	1,900	100	500														
		4.05	13				5.96	2,400	1,200	200	100														
May 19		2.26		Started after washing filter for 20 mins. Used wash water for 15 mins.																					
				1.5	0	9	Admitted filtered water, alum and lime direct to filter for 5 mins, after cleaning.																		
		2.31	1	1.5	0	9	5.17	26,000	26,000	11,500	2,800														
		2.33	2				5.25		18,900		1,600														
		2.35	3				5.21		6,400		1,400								0						
		2.37	4				5.10		2,700		400														
		2.39	5				5.13		10,500		1,100								0	0					
		2.41	6				5.15		12,000		2,300								0						
		2.43	7				5.06	72,000	1,800	11,500	1,800								0	0					
		2.45	8				5.08		8,000		2,000								0						
		3.00	9				5.17	136000	12,000	36,000	1,700														
		3.30	10				5.27	81,000	6,200	22, 00	1,700								0						
		4.00	11				5.38	81,000	9,500	28,000	1,600								0						
		4.30	12				5.50	16,000	1,900	22,000	1,300								0						
		5.00	13				5.56	80,000	2,800	30,000	1,100								0						
May 20	9.15		14	1.05	0	9	7.60	72,000	6,400	68,000	2,400								0	0		+			
		2.07		Started after washing filter for 25 mins. Used wash water for 15 mins.																					
		2.12	1	1.5	0	9	4.79		32,000		1,200								0	0					
		2.14	2				4.88	64,000	31,000	22,000	1,600														
		1.16	3				4.92		22,000		3,700														
		2.18	1				4.83		19,000		1,400								0						
		2.20	5				4.85		20,000		1,800								0	0		+			
		2.22	6				4.88	81,000	11,000	11,000	3,800			+					0			+			
		2.24	7				4.88		8,500		7,500								0		+	+			
		2.26	8				4.88		14,000		1,600									+	+	+			
		2.45	9				4.90	78,000	7,500	21,000	2,700			+					0	+	+	+			
		3.15	10				5.02	86,000	7,900	18,000	3,400	0		+					0		+	+	+		
		3.45	11				5.08	88,000	6,700	28,000	1,100			+							+	+	+		
		4.15	12				5.13	88,000	8,000	2,000	2,900								0		+		+		
		4.45	13				5.27	80,000	7,800	46,000	3,200	0							0	0	+		+		
May 21	9.00			Head lost			8.13																		
		1.43		Started after washing filter for 25 mins. Used wash water for 15 mins.																					
				1.5	0	9	Admitted filtered water, alum and lime to filter for 5 mins. after starting.																		
		1.48	1	1.5	0	9	5.33		8,000		1,400								0		+				

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

(Operating at rate of 80,000,000 Imp. gals. per acre per day.)

Date.	Hour. A.M.	Hour. P.M.	Serial No.	Grains of Chemicals added per U.S. gallon. Alum.	Soda Ash.	Lime.	Max. loss of Head.	Bacterial Counts. 18°-22° C Inf.	18°-22° C Eff.	37° C Inf.	37° C Eff.	Colon Bacilli (0 = negative reaction, + = positive reaction). Influent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	Effluent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
May 21		1.50	2				5.50	36,000	6,600	6,300	900														
		1.52	3				5.35		4,200		340								0	0					
		1.54	4				5.44		1,400		210								0	0					
		1.56	5				5.42		1,500		190								0	0					
		1.58	6				5.40	22,000	1,650	20,500	230	0							0						
		2.00	7				5.42		860		160								0	0					
		2.02	8				5.42		880		170								0						
		2.15	9				5.46	43,500	410	11,000	120								0	0					
		2.45	10				5.63	24,000	790	10,000	70								0	0					
		3.15	11				5.90	42,000	520	6,600	60								0	0	0				
		3.45	12				6.00	23,000	240	6,400	100								0		0				
		4.15	13				6.08	21,000	110	5,800	70								0	0					
May 22				Head lost during the night.																					
		1.55		Started after washing filter for 25 mins. Used wash water for 25 mins.																					
				Alum and lime to filter for 5 mins after starting. For first 2 mins contaminated water was added, followed by filtered water for 3 mins.																					
		2.00	1	1.5	0	9	4.92		6,800		540								0	0		+			
		2.02	2				4.96	18,000	7,200	2,300	920	0							0	0		+			
		2.04	3				4.98		3,200		920								0			+			
		2.06	4				5.00		2,800		220								0			+			
		2.08	5				5.13		2,800		690											+			
		2.10	6				5.08	22,000	1,900	7,600	460	0							0	0		+			
		2.12	7				5.06		10		790								0			+			
		2.14	8				5.10		2,400		520								0	0		+			
		2.30	9				5.17	44,000	2,200	6,500	460								0			+			
		3.00	10				5.29	112000	3,000	19,000	1,150				+				0	0		+			
		3.30	11				5.56	58,000	1,700	17,000	890	0			+				0			+			
		4.00	12				5.69	48,000	4,000	16,000	1,600								0			+			
		4.30	13				5.71	26,000	850	7,800	440	0							0			+			
May 23		4.00		Head Lost.			8.13																		
May 27	11.21			Started after washing filter for one hour.																					
				1.5	2	0	Admitted alum and soda ash for 5 mins. after starting. By mistake filtered water was not added.																		
	11.26		1	1.5	2	0	5.00		4,800		4,800														
	11.28		2				5.02	34,000	900	14,500	5,200	0							0	0	0				
	11.30		3				5.06		4,400		1,250								0	0	0				
	11.32		4				5.04		4,800		1,050								0						
	11.34		5				5.02		2,900		650								0	0					
	11.36		6				5.04	52,000	4,800	5,700	770	0							0	0	0				
	11.38		7				4.98		5,600		1,600								0		+				

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

Date.	Hour. A.M.	Hour. P.M.	Serial No.	Grains of Chemicals added per U.S. gallon. Alum.	Soda Ash.	Lime.	Max. loss of Head.	Bacterial Counts. 18°-22° C Inf.	18°-22° C Eff.	37° C Inf.	37° C Eff.	Colon Bacilli. 0=negative reaction, +=positive reaction. Influent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	Effluent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
May 27	11.40		8				5.04		5,200		1,550								0	0	+	+			
	11.55		9				5.08	88,000	7,600	800	810	0			+				0	0	0	+			
		12.25	10				5.27	88,000	5,600	3,200	470	+		+	+				0	0	+	+			
		12.55	11				5.44	32,000	2,250	600	340	0	0		+				0	0	+	+			
		1,25	12				5.60	52,000	2,100	1,200	620	0	0	+					0	0	0	+			
		1.55	13				5.77	18,000	3,600	400	320	0	0	0					0	0	0	+			
				Head lost during the night.																					
May 28	01 0			Started after washing filter for 25 mins. Used wash water for 20 mins.																					
				1.5	2	0	Admitted filtered water, alum and soda ash direct to filter for 5 mins. after starting.																		
	10.17		1	1.5	2	0	5.48		4,800		7,400								0	0	0				
	10.19		2				5.54	1,700	4,800	1,700	2,400	0	0	0					0	0	0	+			
	10.21		3				5.56		900		1,200								0	0	0	0			
	10.23		4				5.58		210		360								0	0	0	0			
	10.25		5				5.44		640		370								0	0	0	0			
	10.27		6				5.58	8,200	360	5,800	350	0	0	0					0	0	0	0			
	10.29		7				5.58		170		180								0	0	0	0			
	10.31		8				5.58		130		310								0	0	0	0			
	10.45		9				5.63	172000	860	1,600	310	0							0	0	0	0			
	11.15		10				5.83	116000	1,600	900	510	0	0	0	+				0	0		+			
	11.45		11				5.98	104000	1,700	3,300	1,050	0							0	0	0	+			
		12.15	12				6.13	49,000	1,100	4,100	510	0							0	0	0	+			
		12.45	13				6.23	47,000	550	6,900	640	0	0						0			+			
May 29	11.24			Started after washing filter for 20 mins. Used wash-water for 15 mins.																					
				1.5	2	0	Admitted filtered water, alum and soda ash direct to filter for 5 mins. after starting.																		
	11.29		1	1.5	2	0	5.08		2,800		780								0	0	0				
	11.31		2				5.04	11,000	3,000	3,800	770	0	0	+	+				0	0					
	11.33		3				5.04		2,200		290								0	0	0				
	11.35		4				5.13		2,000		660								0	0	0				
	11.37		5				5.13		2,800		430								0	0	0				
	11.39		6				5.13	1.600	2,000	900	300	0	0	+					0	0	0				
	11.41		7				5.10		760		250								0	0	0				
	11.43		8				5.15		520		200								0	0					
	12.00		9				5.29	32,000	6,400	800	170	0	0	+	+				0	0	0	+			
		12.30	10				5.48	68,000	7,200	2,700	270	0	+	+	+				0	0		+			
		1.00	11				5.58	82,000	8,000	6,100	480	0	+	+	+				0	0	+	+			
		1.30	12				5.77	108000	9,200	4,700	240	0			+				0	0					
		2.00	13				5.92	68,000	6,400	1,900	520	0	+	+					0	0	+	+			
				Head lost during the night.																					
June 4	8.48			Started after Washing filter for 15 mins.																					
				1.5	3	0	Admitted filtered water, alum and soda ash direct to filter for 10 mins. after starting.																		
	8.58		1	1.5	3	0	1.42		700		330								0	0	0	0			
	9.00		2				1.44	21,000	430	15,000	540	0	0	0					0	0	0	0			

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
June 4	9.02	......	3	......	......	......	1.42	......	940	......	830	......	......	......	......	......	......	......	0	0	0			......	......
	9.04	......	4	......	......	......	1.46	......	700	......	(Spr.)	......	......	......	......	......	......	......	0	0		0		......	......
	9.06	......	5	......	......	......	1.42	......	800	......	710	......	......	......	......	......	......	......	0	0				......	......
	9.08	......	6	......	......	......	1.40	108000	840	72,000	180	0	0	0			......	......	0					......	......
	9.10	......	7	......	......	......	1.42	......	9,600	......	1,050	......	......	......	......	......	......	......	0	0	0			......	......
	9.12	......	8	......	......	......	1.42	......	7,200	......	2,200	......	......	......	......	......	......	......	0	0	0			......	......
	9.30	......	9	......	......	......	1.50	88,000	10,800	3,800	950	0	0		+		......	......	0	0				......	......
	10.00	......	10	......	......	......	1.77	88,000	7,600	4,900	880	0	+		+	+	......	......	0	0			+	......	......
	10.30	......	11	......	......	......	2.38	68,000	8,200	13,000	2,400	0	+		+	+	......	......	0	0				......	......
	11.00	......	12	......	......	......	3.06	36,000	3,400	22,000	3,800	+	+		+	+	......	......	0					......	......
	11.30	......	13	......	......	......	3.79	32,000	3,200	26,000	2,400	+			+	+	......	......	0					......	......
	12.00	......	14	......	......	......	4.63	72,000	1,800	7,000	1,550	+			+	+	......	......	0	0			+	......	......
	......	12.30	15	......	......	......	5.52	24,000	1,650	3,200	1,800				+	+	......	......	0				+	......	......
	......	1.00	16	......	Head	lost	8.13	42,000	1,850	14,000	1,100				+	+	......	......	0				+	......	......
June 5	8.38			Started after cleaning filter for 15 mins.																					
				1.5	3	0	Admitted filtered water, soda ash and alum direct to filter for 5 mins. after starting.																		
	8.43	......	1	1.5	3	0	1.42	......	5,600	......	410	......	......	......	......	......	......	......	0	0	0		+	......	......
	8.45	......	2	......	......	......	1.42	16,800	1,200	2,900	1,400	0					......	......	0	0	0		+	......	......
	8.47	......	3	......	......	......	1.42	......	5,400	......	420	......	......	......	......	......	......	......	0	0	0		+	......	......
	8.49	......	4	......	......	......	1.42	......	5,200	......	820	......	......	......	......	......	......	......	0	0	0		+	......	......
	8.51	......	5	......	......	......	1.42	......	7,600	......	490	......	......	......	......	......	......	......	0	0	0		+	......	......
	8.53	......	6	......	......	......	1.46	66,000	6,800	22,000	150	0					......	......	0	0	0		+	......	......
	8.55	......	7	......	......	......	1.42	......	6,600	......	840	......	......	......	......	......	......	......	0	0	0		+	......	......
	8.57	......	8	......	......	......	1.46	......	4,800	......	1,760	......	......	......	......	......	......	......	0		0		+	......	......
	9.15	......	9	......	......	......	1.52	120000	9,000	12,000	1,200	0	+			+	......	......	0	0			+	......	......
	9.45	......	10	......	......	......	1.81	98,000	7,600	8,600	490	+	+			+	......	......	0	0			+	......	......
	10.15	......	11	......	......	......	2.08	112000	6,800	17,000	510	+	+		+	+	......	......	0	0			+	......	......
	10.45	......	12	......	......	......	2.41	86,000	6,200	13,000	590	0	+		+	+	......	......	0	0	0		+	......	......
	11.15	......	13	......	......	......	2.81	92,000	5,400	11,000	380	+	+		+	+	......	......	0	0		+	+	......	......
	11.45	......	14	......	......	......	3.23	82,000	6,200	2,500	40	+			+	+	......	......	0	0			+	......	......
	......	12.15	15	......	......	......	3.83	48,000	4,400	2,500	120	0	0		+	+	......	......	0	0	0			......	......
	......	1.15	16	......	......	......	4.71	48,000	3,800	1,800	60	0	0		+	+	......	......	0	0	0		+	......	......
	......	1.45	17	......	......	......	5.33	16,500	2,200	1,800	100	0	0		+	+	......	......	0	0	0	0	+	......	......
	......	2.15	18	......	Head	lost	8.13	12,000	1,100	800	20	0			+	+	......	......	0	0	0	0	+	......	......
June 9	7.32			Started after washing filter for 11 mins. Used wash water for 9 mins.																					
				1.5	3	0	Admitted filtered water, alum and soda ash direct to filter for 5 mins. after starting.																		
	7.37	......	1	1.5	3	0	1.42	......	3,300	......	780	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.39	......	2	......	......	......	1.42	6,100	1,800	48,000	840	0	0	0			......	......	0	0	0	+	+	......	......

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour. A.M.	Hour. P.M.	Serial No.	Grains of Chemicals added per U.S. gallon. Alum.	Soda Ash.	Lime.	Max. loss of Head.	Bacterial Counts. 18°-22° C Inf.	18°-22° C Eff.	37° C Inf.	37° C Eff.	Colon Bacilli. 0=negative reaction, +=positive reaction. Influent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	Effluent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																									
June 9	7.41	......	3	......	......	......	1.41	......	1,300	......	770	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.43	......	4	......	......	......	1.44	......	460	......	320	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.45	......	5	......	......	......	1.46	......	2,800	......	420	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.47	......	6	......	......	......	1.48	4,100	340	88,000	1,200	0	0	+	+	+	......	......	0	0	0	0	+	......	......
	7.49	......	7	......	......	......	1.50	......	290	......	80	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.51	......	8	......	......	......	1.50	......	340	......	190	......	......	......	......	......	......	......	0	0	0	0	+	......	......
	8.05	......	9	......	......	......	1.67	15,800	40	16,000	30	0	0	0	0	+	......	......	0	0	+	+	+	......	......
	8.35	......	10	......	......	......	2.13	1,900	90	4,100	60	0	0	+	+	+	......	......	0	0	0	+	+	......	......
	9.05	......	11	......	......	......	2.46	2,100	130	4,600	10	0	+	+	+	+	......	......	0	0	+	0	+	......	......
	9.35	......	12	......	......	......	2.96	2,600	340	5,300	260	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	10.05	......	13	......	......	......	3.46	4,200	560	5,900	830	0	+	+	+	+	......	......	0	0	0	+	+	......	......
	10.35	......	14	......	......	......	3.90	13,300	2,000	3,900	390	+	+	+	+	+	......	......	0	0	0	+	+	......	......
	11.05	......	15	......	......	......	4.29	14,200	1,600	4,800	270	+	0	+	+	+	......	......	0	0	0	0	+	......	......
	11.35	......	16	......	......	......	4.67	19,000	1,500	8,600	320	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	......	12.05	17	......	......	......	5.13	20,500	1,400	9,000	250	+	0	+	+	+	......	......	0	0	0	+		......	......
	......	12.35	18	......	......	......	5.67	11,500	1,200	7,200	780	0	+	+	+	+	......	......	0	0	0	+		......	......
June 10	7.25	......	......	1.5	3	0	Started after washing the filter for 9 mins. Used wash water for 7½ mins.																		
				Admitted filtered water, alum and soda ash direct to filter for 5 minutes after starting.																					
	7.30	......	......	Cut off filtered water and soda ash and admitted polluted water and alum through storage tank.																					
	7.30	......	1	1.5	0	0	1.52	......	5,200	......	1,350	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.32	......	2	......	......	......	1.52	14,500	3,600	7,000	1,050	0	0	+	+	+	......	......	0	0	+	+	+	......	......
	7.34	......	3	......	......	......	1.54	......	3,200	......	930	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.36	......	4	......	......	......	1.54	......	1,100	......	560	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.38	......	5	......	......	......	1.51	......	1,800	......	440	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.40	......	6	......	......	......	1.51	19,000	720	8,900	160	0	0	+	+	+	......	......	0	0	0	+	+	......	......
	7.42	......	7	......	......	......	1.56	......	2,100	......	330	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.44	......	8	......	......	......	1.58	......	2,300	......	390	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	8.00	......	9	......	......	......	1.60	30,000	2,600	13,000	2,550	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	8.30	......	10	......	......	......	1.90	26,000	2,800	9,600	1,450	0	0	+	+	+	......	......	0	0	0	+	+	......	......
	9.00	......	11	......	......	......	2.31	18,000	1,600	17,000	1,050	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	9.30	......	12	......	......	......	2.85	36,500	1,200	22,000	470	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	10.00	......	13	......	......	......	3.60	23,000	2,600	23,000	470	0	+	+	+	+	......	......	0	0	0	+	+	......	......
	10.30	......	14	......	......	......	4.29	27,000	3,200	21,000	350	+	+	+	+	+	......	......	0	0	+	+	+	......	......
	11.00	......	15	......	......	......	5.27	31,000	2,600	21,000	490	+	+	+	+	+	......	......	0	0	0	+	+	......	......
	11.30	......	16	......	Head	lost	8.13	28,000	2,400	22,000	90	0	+	+	+	+	......	......	0	0	0	+	+	......	......
June 11	7.15	......	......	1.5	3	0	Started after washing filter for 8 mins. Used wash water for 6½ mins.																		
				Admitted filtered water, soda ash and alum direct to filter for 5 mins. after starting.																					
	7.20	......	......	Cut off filtered water and soda ash and admitted polluted water and alum through storage tank.																					
	7.20	......	1	1.5	0	0	1.46	......	2,800	......	1,050	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.22	......	2	......	......	......	1.46	8,400	3,000	8,600	Hy.	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	7.24	......	3	......	......	......	1.50	......	1,300	......	1,150	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.26	......	4	......	......	......	1.50	......	620	......	420	......	......	......	......	......	......	......	0	0	0	+	+	......	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction, + = positive reaction													
								18°–22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 June 11	7.28		5	......	......	......	1.54	......	660	......	170	......	......	......	......	......	......	......	0	0	0		+	......	......
	7.30		6	......	......	......	1.56	3,100	310	2,700	120	0	0	0			......	......	0	0		+	+	......	......
	7.32		7	......	......	......	1.58	......	150	......	780	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.34		8	......	......	......	1.60	......	110	......	260	......	......	......	......	......	......	......	0	0		+	+	......	......
	7.50		9	......	......	......	1.79	4,100	60	2,600	70	0					......	......	0	0	0	+	+	......	......
	8.20		10	......	......	......	2.21	2,400	20	2,400	20	0			+		......	......	0	0	0	0	+	......	......
	8.50		11	......	......	......	2.60	2,900	60	3,100	60	0		+	+		......	......	0	0	0	+	+	......	......
	9.20		12	......	......	......	3.40	5,800	110	8,200	230	0		+	+		......	......	0	0	0	+	+	......	......
	9.50		13	......	......	......	3.83	5,700	0	9,500	610	+		+	+		......	......	0	0	0	+	+	......	......
	10.20		14	......	......	......	4.21	10,500	790	8,300	1,730	0		+	+		......	......	0	0	+	+	+	......	......
	10.50		15	......	......	......	4.63	19,000	430	13,500	720	+		+	+		......	......	0	0	+	+	+	......	......
	11.20		16	......	......	......	4.96	8,200	2,000	7,700	1,700	0		+	+		......	......	0	0	+	+	+	......	......
	11.50		17	......	......	......	5.35	17,600	1,300	24,000	1,800	0		+	+		......	......	0	0	+	+	+	......	......
	......	12.20	18	......	......	......	5.75	6,100	1,200	15,500	2,300	0		+			......	......	0		+	+	+	......	......
	......	12.23	......	Head Lost.			8.13	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Note. A count too heavy to determine is denoted by (Hv.)																									
June 15	7.58		......	1.5	0	0	Started after washing filter for 14 mins. Used wash water for 11 mins. Admitted filtered water and alum direct to filter for 5 mins. after starting.																		
	8.03		1	1.5	0	0	1.60	......	880	......	290	......	......	......	......	......	......	......	0	0		+	+	......	......
	8.05		2	......	......	......	1.58	10,000	820	6,400	720	+					......	......	0	0				......	......
	8.07		3	......	......	......	1.52	......	820	......	860	......	......	......	......	......	......	......	0	0				......	......
	8.09		4	......	......	......	1.52	......	960	......	920	......	......	......	......	......	......	......	0	0				......	......
	8.11		5	......	......	......	1.50	......	1,100	......	920	......	......	......	......	......	......	......	0		0			......	......
	8.13		6	......	......	......	1.50	11,000	1,400	8,800	960	0	0				......	......	0	0				......	......
	8.15		7	......	......	......	1.50	......	1,200	......	960	......	......	......	......	......	......	......	0		0			......	......
	8.17		8	......	......	......	1.48	......	1,200	......	980	......	......	......	......	......	......	......						......	......
	8.30		9	......	......	......	1.48	18,100	1,250	8,200	1,000	0		+		+	......	......	0					......	......
	9.00		10	......	......	......	1.54	18,000	1,200	8,000	1,000	0		+		+	......	......	0	0	0			......	......
	9.30		11	......	......	......	1.67	14,000	860	7,800	960	0	0	+		+	......	......	0	0	0			......	......
	10.00		12	......	......	......	1.75	14,000	800	6,200	890	0	+	+		+	......	......	0	0				......	......
	10.30		13	......	......	......	1.88	13,500	720	5,400	880	0	0	+		+	......	......	0	0		+		......	......
	11.00		14	......	......	......	1.98	17,000	3,200	3,900	1,500	0		+		+	......	......	0	0				......	......
	11.30		15	......	......	......	2.06	9,300	6,000	3,900	700	0	0	+	+	+	......	......	0					......	......
	12.00		16	......	......	......	2.21	10,500	950	5,600	1,200	0		+		+	......	......	0	0				......	......
	......	12.30	17	......	......	......	2.31	4,600	780	5,200	140	0	0	+	+	+	......	......	0			+	+	......	......
	......	1.00	18	......	......	......	2.48	5,600	950	4,900	500	0	0	+		+	......	......	0	0		+	+	......	......

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0=negative reaction +=positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 June 16	7.31	......		1.5	0	0	Started after washing filter for 14 mins. Used wash water for 10 mins. Admitted filtered water and alum direct to filter for 5 mins. after starting.																		
	7.36		1	1.5	0	0	1.65	......	1,200	......	340	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.38		2	......	......	......	1.65	10,500	1,150	3,900	320	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	7.40		3	......	......	......	1.60	......	950	......	320	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	7.42		4	......	......	......	1.67	......	900	......	500	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.44		5	......	......	......	1.67	......	900	......	360	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.46		6	......	......	......	1.67	24,000	880	7,200	480	0	+	+	+	+	......	......	0	+	+	+	+	......	......
	7.48		7	......	......	......	1.67	......	900	......	360	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.50		8	......	......	......	1.67	......	950	......	320	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	8.05		9	......	......	......	1.71	72,000	6,400	10,500	590	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	8.35		10	......	......	......	1.81	68,000	6,400	18,000	330	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	9.05		11	......	......	......	1.96	50,000	2,800	7,800	540	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	9.35		12	......	......	......	2.10	56,000	2,900	13,500	390	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	10.05		13	......	......	......	2.21	18,000	1,100	11,500	380	+	+	+	+	+	......	......	0	0	+	+	+	......	......
	10.35		14	......	......	......	2.38	18,000	800	5,400	190	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	11.05		15	......	......	......	2.54	10,500	670	5,100	230	+	+	+	+	+	......	......	0	+	+	+	+	......	......
	11.35	......	16	......	......	......	2.71	13,500	570	15,500	460	0	0	+	+	+	......	......	0	0	+	+	+	......	......
	......	12.05	17	......	......	......	2.83	13,000	480	10,500	240	0	0	+	+	+	......	......	0	0	0	+	+	......	......
	......	12.35	18	......	......	......	3.04	27,000	1,400	11,000	670	0	+	+	+	+	......	......	0	0	+	+	+	......	......
June 17	7.27	......		1.5	3	0	Started after washing filter for 22 mins. Used wash water for 19 mins. Admitted filtered water, alum and soda ash direct to filter for 5 mins. after starting.																		
	7.32	......	1	1.5	3	0	1.56	......	710	......	190	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.34	......	2	......	......	......	1.60	36,000	740	1,800	390	0	0	+	+	+	......	......	0	0	0	+	+	......	......
	7.36	......	3	......	......	......	1.58	......	740	......	170	......	......	......	......	......	......	......	0	+	+	+	+	......	......
	7.38	......	4	......	......	......	1.52	......	1,450	......	510	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.40	......	5	......	......	......	1.56	......	760	......	230	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.42	......	6	......	......	......	1.56	4,300	560	2,100	180	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	7.44	......	7	......	......	......	1.56	......	670	......	150	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.46	......	8	......	......	......	1.58	......	680	......	160	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	8.00	......	9	......	......	......	1.63	12,300	440	5,000	150	0	0	+	+	+	......	......	0	0	0	+	+	......	......
	8.30	......	10	......	......	......	1.79	9,500	1,100	2,600	420	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	9.06	......	11	......	......	......	1.96	4,500	810	2,600	610	0	+	+	+	+	......	......	0	0	+	+	+	......	......
	9.30	......	12	......	......	......	2.13	4,700	610	1,800	480	0	0	0	+	+	......	......	0	0	0	+	+	......	......
	10.00	......	13	......	......	......	2.29	1,400	460	1,600	310	0	+	+	+	+	......	......	0	0	0	0	+	......	......
	10.30	......	14	......	......	......	2.48	1,400	320	260	110	......	0	+	+	+	......	......	......	0	0	+	+	......	......
	11.00	......	15	......	......	......	2.67	950	360	270	210	......	0	0	+	+	......	......	......	0	0	0	+	......	......
	11.30	......	16	......	......	......	2.88	720	180	330	110	......	0	+	+	+	......	......	......	0	0	0	+	......	......
	12.00	......	17	......	......	......	3.08	1,300	100	720	320	......	0	0	+	+	......	......	......	0	+	+	+	......	......
	......	12.30	18	......	......	......	3.27	950	140	740	175	......	0	+	+	+	......	......	......	0	0	+	+	......	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°-22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 June 18	7.26	......	......	1.5	0	0	Started after washing filter for 10 mins. Used wash water for 7 mins.																		
				Admitted filtered water and alum direct to filter for 5 mins. after starting.																					
	7.31	......	1	1.5	0	0	1.63	......	8,500	......	310	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.33	......	2	......	......	......	1.56	6,500	1,600	3,500	490	0					......	......	0	0	+	+	+	......	......
	7.35	......	3	......	......	......	1.56	......	1,400	......	800	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.37	......	4	......	......	......	1.56	......	1,200	......	410	......	......	......	......	......	......	......	0	0	0	+	+	......	......
	7.39	......	5	......	......	......	1.56	......	1,100	......	240	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.41	......	6	......	......	......	1.58	10,500	1,800	8,100	270						......	......	0	0	0	+	+	......	......
	7.43	......	7	......	......	......	1.58	......	1,100	......	360	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	7.45	......	8	......	......	......	1.58	......	1,100	......	170	......	......	......	......	......	......	......	0	0	+	+	+	......	......
	8.00	......	9	......	......	......	1.63	6,500	2,600	3,100	500	0	0	+	+	+	......	......	0	0	+	+	+	......	......
	8.30	......	10	......	......	......	1.79	9,600	650	6,100	430		0	+	+	+	......	......	0	0	0	+	+	......	......
	9.00	......	11	......	......	......	2.00	11,000	490	11,000	260	0	0	+	+	+	......	......	0	0	0	+	+	......	......
	9.30	......	12	......	......	......	2.23	4,900	440	6,900	160	0	0	+	+	+	......	......	0	0	0	+	+	......	......
	10.00	......	13	......	......	......	2.40	6,700	560	5,400	240	0		+	+	+	......	......	0	0	0	+	+	......	......
	10.30	......	14	......	......	......	2.77	11,000	650	1,200	140	0		+	+	+	......	......	0	0	+	+	+	......	......
	11.00	......	15	......	......	......	3.10	12,000	340	10,500	250	0		+	+	+	......	......	0	0	0	+	+	......	......
	11.30	......	16	......	......	......	3.38	12,500	330	11,000	190	+		+	+	+	......	......	0	0	+	+	+	......	......
	12.00	......	17	......	......	......	3.69	7,300	440	9,500	560	0		+	+	+	......	......	0	0	+	+	+	......	......
	......	12.30	18	......	......	......	4.00	8,700	590	6,500	910	0		+	+	+	......	......	0	+	0	+	+	......	......
June 23	7.20	......	......	3	3	0	Started after washing filter for 12 mins. Used wash water for 13 mins.																		
				Admitted filtered water, alum and soda ash direct to filter for 5 mins after starting																					
	7.25	......	......	Cut off filtered water and soda ash and admitted polluted water and alum through storage tank																					
	7.50	......	1	3	0	0	1.81	700	140	500	0	0	0	0	+	+	......	......	0	0	0	0	0	+	......
	8.20	......	2	......	......	......	2.00	6,300	180	4,200	20	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	8.50	......	3	......	......	......	2.25	8,000	60	2,800	30	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	9.20	......	4	......	......	......	2.56	8,800	210	5,600	10	0	0	+	+	+	......	......	0	0	0	0	0	+	......
	9.50	......	5	......	......	......	2.94	6,600	80	4,300	10	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	10.20	......	6	......	......	......	3.67	19,000	100	1,800	10	0	+	+	+	+	......	......	0	0	0	0	0	+	......
	11.20	......	7	......	......	......	4.42	27,000	330	3,900	120	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	11.50	......	8	......	......	......	4.92	30,000	130	7,200	40	0	+	+	+	+	......	......	0	0	0	+	+	+	......
	......	12.20	9	......	......	......	5.60	19,000	180	6,800	10	0	+	+	+	+	......	......	0	0	0	0	+	+	......
June 24	7.47	......	......	3	6	0	Started after washing filter for 15 mins. Used wash water for 17 mins																		
				Admitted filtered water, alum and soda Ash direct to filter for 5 mins after starting.																					
	7.52	......	......	Cut off filtered water and soda ash, and admitted polluted water and alum through storage tank.																					
	8.02	......	1	3	0	0	1.71	100	240	100	50	0	0	0	+	+	......	......	0	0	0	0	+	+	......
	8.30	......	2	......	......	......	1.98	600	180	900	60	0	+	+	+	+	......	......	0	0	0	+	+	+	......
	9.00	......	3	......	......	......	2.17	3,200	60	2,200	40	0	+	+	+	+	......	......	0	0	0	0	+	+	......

OPERATING DATA

THE RAPID SAND-MECHANICAL GRAVITY FILTER.

Date.	Hour.		Serial No.	Grains of Chemicals added per U.S. gallon.			Max. loss of Head.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
								18°–22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Alum.	Soda Ash.	Lime.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 June 24	9.30	......	4	......	......	......	2.33	2,700	60	4,100	290	0	0	+	+	+	......	......	0	0	0	+	+	+	......
	10.00	......	5	......	......	......	2.46	2,900	10	6,100	60	0	0	+	+	+	......	......	0	0	0	+	+	+	......
	10.30	......	6	......	......	......	2.85	5,800	0	2,400	50	+	+	+	+	+	......	......	0	0	0	0	+	+	......
	11.00	......	7	......	......	......	3.17	7,100	30	3,400	40	0	+	+	+	+	......	......	0	0	0	+	+	+	......
	11.30	......	8	......	......	......	3.46	5,300	30	5,600	30	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	12.00	......	9	......	......	......	3.90	6,600	0	5,400	10	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	......	12.30	10	......	......	......	4.27	9,500	20	9,100	40	+	+	+	+	+	......	......	0	0	0	0	+	+	......
	......	2.00	....	Started after washing filter																					
	......	4.15	11	3	0	0	2.73	16,000	60	2,000	10	0	0	+	+	+	......	......	0	0	0	0	0	+	......
	......	4.45	12	......	......	......	3.38	11,000	30	1,800	30	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	......	4.50	....	Stopped filter running.																					
June 25	7.12	......	....	Started filter running without washing it.																					
	7.14	......	13	3	0	0	1.81	4,700	300	2,100	860	0	0	0	0	+	......	......	0	0	0	0	+	+	......
	7.30	......	14	......	......	......	1.85	2,700	510	1,800	120	0	0	0	+	+	......	......	0	0	0	+	+	+	......
	7.45	......	15	......	......	......	1.48	600	120	1,000	30	0	0	+	+	+	......	......	0	0	0	0	+	+	......
	8.00	......	16	......	......	......	2.71	1,200	280	800	120	0	0	+	+	+	......	......	0	0	0	0	+	+	......
	8.30	......	....	3	6	0	Started after washing filter for 12 mins. Used wash water for 10 mins.																		
	......	......	....	Admitted filtered water, alum and soda ash direct to filter for 5 minutes after starting.																					
	8.35	......	....	Cut off filtered water and soda ash, and admitted polluted water and alum through storage tank.																					
	8.50	......	1	3	0	0	1.83	1,100	60	3,200	110	0	0	0	+		......	......	0	0	0	0	+	+	......
	9.10	......	2	......	......	......	1.92	1,800	80	1,900	20	0	0	+	+	+	......	......	0	0	0	0	0	+	......
	9.30	......	3	......	......	......	2.00	2,900	20	1,300	0	0	0	+	+		......	......	0	0	0	0	0	+	......
	9.50	......	4	......	......	......	2.19	2,900	20	2,900	10	0	0	0	+	+	......	......	0	0	0	0	0	0	......
	10.10	......	5	......	......	......	2.29	1,900	30	2,700	30	0	0	+	+	+	......	......	0	0	0	+	+	+	......
	10.30	......	6	......	......	......	2.44	9,500	20	1,500	30	0	+	+	+	+	......	......	0	0	0	+	+	+	......
	10.50	......	7	......	......	......	2.54	8,600	110	1,300	10	0	0	+	+	+	......	......	0	0	+	+	+	+	......
	11.10	......	8	......	......	......	2.71	3,900	20	2,600	10	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	11.30	......	9	......	......	......	2.81	3,700	70	1,800	20	0	0	+	+	+	......	......	0	0	0	+	+	+	......
	11.50	......	10	......	......	......	2.91	18,000	1,550	2,300	20	0	+	+	+	+	......	......	0	+	+	+	+	+	......
	......	2.00	....	Started after washing filter.																					
	......	4.45	11	3	0	0	3.29	17,000	60	1,700	50	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	......	5.15	12	......	......	......	3.42	10,500	40	2,300	0	0	0	+	+	+	......	......	0	0	0	0	+	+	......
	......	5.20	....	Stopped filter running.																					
June 26	7.18	......	....	Started filter running without washing it.																					
	7.20	......	13	3	0	0	3.67	800	2,400	300	1,150	0	0	+	+	+	......	......	0	0	+	+	+	+	......
	7.35	......	14	......	......	......	3.83	1,900	240	800	670	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	7.50	......	15	......	......	......	4.00	4,300	210	3,000	70	+	+	+	+	+	......	......	0	0	0	0	+	+	......
	8.05	......	16	......	......	......	4.21	1,400	110	2,700	110	0	+	+	+	+	......	......	0	0	0	0	+	+	......
	8.25	......	....	3	6	0	Started after washing filter for 12 mins. Used wash water for 10½ mins.																		
	......	......	....	Admited filtered water, alum and soda ash direct to filter for 5 mins. after starting.																					
	8.30	......	....	Cut off filtered water and soda ash and admitted polluted water and alum through storage tank.																					
	8.45	......	1	3	0	0	1.81	2,600	80	800	70	......	......	......	......	......	......	......	......	......	......	......	......	......	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

The Rapid Sand-Mechanical Gravity Filter.

(Operating at rate of 80,000,000 Imp. gals. per acre per day)

Date.	Hour. A.M.	Hour. P.M.	Serial No.	Grains of Chemicals added per U.S. gallon. Alum.	Soda Ash.	Lime.	Max. loss of Head.	Bacterial Counts. 18°-22° C. Inf.	Eff.	37° C. Inf.	Eff.	Colon Bacilli. 0 = negative reaction, + = positive reaction. Influent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	Effluent. .001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914 June 26	9.05	......	2	......	......	......	1.96	3,500	220	1,200	0	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	9.25	......	3	......	......	......	2.02	1,300	160	2,700	10	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	9.45	......	4	......	......	......	2.17	2,400	60	3,100	120	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	10.05	......	5	......	......	......	2.31	1,500	50	4,600	30	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	10.25	......	6	......	......	......	2.50	7,700	43	2,700	24	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	10.45	......	7	......	......	......	2.60	4,900	73	3,800	15	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	11.05	......	8	......	......	......	2.77	8,500	11	2,300	53	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	11.25	......	9	......	......	......	2.96	8,900	18	7,800	11	......	......	......	......	......	......	......	......	......	......	......	......	......	......
	11.45	......	10	......	......	......	3.10	13,400	11	9,100	17	......	......	......	......	......	......	......	......	......	......	......	......	......	......
July 13	8.40	......	......	6	0	0	Started after washing filter for 10 mins. Admitted filtered water and alum direct to filter for 5 mins. after starting.																		
	8.45	......	......				Cut off filtered water and admitted polluted water and alum through storage tank.																		
	9.00	......	1	6	0	0	2.19	900	130	100	11	0	+	+	+	+	......	......	......	......	0	+	+	+	+
	9.30	......	2	......	......	......	2.35	3,800	680	300	9	0	0	+	+	+	......	......	......	......	+	+	+	+	+
	10.00	......	3	......	......	......	2.54	9,500	83	800	8	0	+	+	+	+	......	......	......	......	0	+	+	+	+
	10.30	......	4	......	......	......	2.73	2,400	120	800	14	0	+	+	+	+	......	......	......	......	0	+	+	+	+
	11.00	......	5	......	......	......	2.96	2,200	125	1,800	9	0	+	+	+	+	......	......	......	......	0	+	+	+	+
July 14	8.30	......	......	6	0	0	Started after washing filter for 15 mins. Admitted filtered water and alum direct to filter for 5 mins. after starting																		
	8.35	......	......	......	......	......	Cut off filtered water and admitted polluted water and alum through storage tank.																		
	9.00	......	1	6	0	0	2.27	19,000	240	8,700	300	0	0	+	+	+	......	......	......	0	+	+	+	+	+
	9.30	......	2	......	......	......	2.46	18,000	320	11,500	90	0	0	0	+	+	......	......	......	0	0	+	+	+	+
	10.00	......	3	......	......	......	2.58	21,000	460	3,600	62	0	+	+	+	+	......	......	......	0	+	+	+	+	+
	10.30	......	4	......	......	......	2.79	19,500	310	4,400	56	+	+	+	+	+	......	......	......	0	+	+	+	+	+
	11.00	......	5	......	......	......	3.00	24,000	320	9,500	30	+	+	+	+	+	......	......	......	+	+	+	+	+	+
July 15	8.12	......	......	6	0	0	Started after washing filter for 10 mins. Admitted filtered water and alum direct to filter for 5 mins. after starting.																		
	8.17	......	......	......	......	......	Cut off filtered water and admitted polluted water and alum through storage tank.																		
	8.30	......	1	6	0	0	2.60	16,000	440	2,600	180	0	+	+	+	+	......	......	......	0	+	+	+	+	+
	9.00	......	2	......	......	......	2.73	13,000	560	2,200	85	0	+	+	+	+	......	......	......	0	+	+	+	+	+
	9.30	......	3	......	......	......	3.10	13,000	480	2,400	73	0	+	+	+	+	......	......	......	0	+	+	+	+	+
	10.00	......	4	......	......	......	3.29	16,000	580	3,400	64	0	0	+	+	+	......	......	......	0	0	+	+	+	+
	10.30	......	5	......	......	......	3.48	12,000	520	4,500	36	+	+	+	+	+	......	......	......	0	0	+	+	+	+

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

SLOW SAND FILTER.

(Operating at rate of 5,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction. + = positive reaction.													
				18°–22° C.		37° C.		Influent.							Effluent.						
	A.M.	P.M.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
January 8	10.30	......	1	320	1	55	4	......	......	......	+	+	+	+	......	......	......	0	0	0	+
	11.00	......	2	380	160	260	4	......	......	......	0	+	+	+	......	......	......	+	+	+	+
	11.30	......	3	320	60	320	6	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	12.00	......	4	560	70	240	7	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	1.30	5	100	90	240	36	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	2.00	6	360	280	180	38	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	2.30	7	360	160	280	27	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	3.00	8	400	160	140	34	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	3.30	9	440	200	210	35	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	......	4.00	10	360	160	280	39	......	......	......	+	+	+	+	......	......	......	+	+	+	+
January 12	9.50	......	1	27	120	4	2	......	......	......	0	0	0	+	......	......	......	0	0	0	0
	9.55	......	2	11	140	1	1	......	......	......	0	0	0	0	......	......	......	0	0	+	0
	10.00	......	3	23	720	1	3	......	......	......	0	0	0	0	......	......	......	0	0	+	0
	10.15	......	4	23	480	5	4	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	10.45	......	5	23	560	4	2	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	11.15	......	6	16	440	1	0	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	11.45	......	7	14	420	8	0	......	......	......	0	0	0	0	......	......	......	0	0	+	0
	......	1.45	8	27	280	3	0	......	......	......	0	0	0	0	......	......	......	0	0	+	0
	......	2.15	9	11	180	4	3	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	......	2.45	10	16	220	6	1	......	......	......	0	0	0	0	......	......	......	0	0	0	0
	......	3.15	11	11	240	10	1	......	......	......	0	0	0	0	......	......	......	0	+	+	+
	......	3.45	12	8	280	6	5	......	......	......	0	0	0	0	......	......	......	0	0	+	+
	......	4.15	13	12	200	8	1	......	......	......	0	0	0	0	......	......	......	0	+	+	+
January 15	9.45	......	1	1	4	4	4	......	......	......	0	0	0	0	......	......	......	+	+	+	+
	10.15	......	2	6	70	12	42	......	......	......	0	0	0	0	......	......	......	0	0	+	+
	10.45	......	3	2	44	0	8	......	......	......	0	0	0	0	......	......	......	+	+	+	+
	11.15	......	4	16	19	0	0	......	......	......	0	0	0	0	......	......	......	0	0	+	+
	11.45	......	5	5	13	3	2	......	......	......	0	0	0	0	......	......	......	0	+	+	+
	......	1.15	6	2	1	0	0	......	......	......	0	0	0	0	......	......	......	0	0	+	+
	......	1.43	7	1	42	0	0	......	......	......	0	0	0	0	......	......	......	0	+	+	+
	......	2.15	8	8	180	2	18	......	......	......	0	0	0	0	......	......	......	0	0	+	+
	......	2.45	9	30	40	14	0	......	......	......	0	+	0	+	......	......	......	0	0	0	+
	......	3.15	10	24	55	16	1	......	......	......	0	+	0	+	......	......	......	0	+	+	+

NOTE.—Influent = infected water before storage. This is not exactly the same as Influent to Mechanical Filter which was examined only after two hours' storage.

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

SLOW SAND FILTER.

(Operating at rate of 5,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Bacterial Counts.				Colon Bacilli 0=negative reaction + = positive reaction													
				18°22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
January 16	9.30	....	1	24	58	0	3	......	......	......	0	0	0	0	......	......	......	0	+	+	+
	10.00	....	2	10	16	6	4	......	......	......	0	0	0	+	......	......	......	0	+	+	+
	10.30	....	3	11	60	3	4	......	......	......	0	0	0	+	......	......	......	0	+	+	+
	11.00	....	4	17	85	7	2	......	......	......	0	0	0	0	......	......	......	0	+	+	+
	11.30	....	5	10	65	3	4	......	......	......	0	0	+	+	......	......	......	0	0	+	+
	12.00	....	6	14	80	3	1	......	......	......	0	0	0	0	......	......	......	0	+	+	+
	....	1.30	7	26	70	5	3	......	......	......	0	0	0	0	......	......	......	0	+	+	+
	....	2.00	8	11	65	0	3	......	......	......	0	0	0	0	......	......	......	0	+	+	+
	....	2.30	9	180	65	110	0	......	......	......	+	+	+	+	......	......	......	0	+	+	+
	....	3.00	10	85	27	70	1	......	......	......	+	+	+	+	......	......	......	0	+	+	+
January 19	....	2.00	1	840	210	350	12	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	....	2.30	2	160	160	240	11	......	......	......	0	+	+	+	......	......	......	+	+	+	+
	....	3.00	3	960	220	480	62	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	....	3.30	4	1,080	260	760	34	......	......	......	+	+	+	+	......	......	......	+	+	+	+
	....	4.00	5	1,440	460	520	9	......	......	......	+	+	+	+	......	......	......	+	+	+	+
January 20	10.30	....	1	640	320	30	220	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	11.00	....	2	38	115	800	65	......	0	0	+	+	+	+	......	+	0	+	+	+	+
	11.30	....	3	480	280	300	70	......	+	0	+	+	+	+	......	+	+	+	+	+	+
	12.00	....	4	2,720	560	220	160	......	0	+	+	+	+	+	......	0	0	+	+	+	+
	....	2.00	5	2,080	360	480	115	......	0	+	+	+	+	+	......	0	0	+	+	+	+
	....	2.30	6	1,720	88	240	85	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	....	3.00	7	1,440	92	300	280	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	....	3.30	8	1,280	18	220	880	......	+	0	+	+	+	+	......	0	0	+	+	+	+
January 21	9.30	....	1	1	160	30	880	......	0	0	0	0	+	+	......	0	0	+	+	+	+
	10.00	....	2	1	140	7	180	......	0	0	0	0	+	+	......	+	0	0	+	+	+
	11.23	....	3	140	35	140	165	......	0	0	0	0	+	+	......	0	0	0	+	+	+
	11.30	....	4	1,760	720	560	480	......	0	0	0	+	+	+	......	0	0	0	0	+	+
	11.45	....	5	65	320	180	880	......	0	0	+	+	+	+	......	0	0	0	+	+	+
	12.00	....	6	360	85	560	620	......	0	0	+	+	+	+	......	0	0	0	+	+	+
	....	2.00	7	95	600	130	170	......	0	0	+	+	+	+	......	0	+	0	+	+	+
	....	2.30	8	1,040	720	760	680	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	....	3.00	9	440	640	160	760	......	0	0	+	+	+	+	......	0	0	0	0	+	+
January 22	9.30	....	1	120	3,200	39	2,600	......	0	0	0	0	+	+	......	0	+	+	+	+	+
	10.00	....	2	240	2,800	480	1,600	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	11.00	....	3	360	460	300	760	......	0	0	0	+	+	+	......	0	0	+	+	+	+
	11.30	....	4	180	380	320	330	......	0	+	0	+	+	+	......	0	0	+	+	+	+
	12.00	....	5	45	210	95	330	......	0	0	0	+	+	+	......	+	0	+	+	+	+
	....	1.30	6	680	410	280	60	......	+	0	0	+	+	+	......	0	0	0	+	+	+

OPERATING DATA

SLOW SAND FILTER.

Date.	Hour A.M.	Hour P.M.	Serial No.	Bacterial Counts 18°-22° C. Inf	Bacterial Counts 18°-22° C. Eff.	Bacterial Counts 37° C. Inf.	Bacterial Counts 37° C. Eff.	Colon Bacilli (0 = negative reaction; + = positive reaction) Influent .001 c.c.	Influent .01 c.c.	Influent .1 c.c.	Influent 1 c.c.	Influent 5 c.c.	Influent 25 c.c.	Influent 50 c.c.	Effluent .001 c.c.	Effluent .01 c.c.	Effluent .1 c.c.	Effluent 1 c.c.	Effluent 5 c.c.	Effluent 25 c.c.	Effluent 50 c.c.
January 22	....	2.00	7	640	290	180	120	......	0	0	0	+	+	+	......	0	+	0	+	+	+
	....	2.30	8	240	280	260	270	......	0	+	+	+	+	+	......	0	0	0	+	+	+
	....	3.00	9	280	60	190	90	......	0	0	+	+	+	+	......	0	0	+	+	+	+
	....	3.30	10	190	80	360	80	......	0	0	+	+	+	+	......	0	0	0	+	+	+
January 23	9.00	....	1	112	1,050	7	40	......	0	0	0	0	+	......	......	0	0	0	+	+	......
	9.30	....	2	72	470	35	70	......	0	0	0	0	+	......	......	0	0	+	+	+	......
	10.30	....	3	1,820	220	28	10	......	0	0	0	0	+	......	......	0	0	0	+	+	......
	11.00	....	4	400	1,200	42	20	......	0	0	0	0	+	......	......	0	0	0	0	+	......
	11.30	....	5	290	1,200	90	30	......	0	0	0	0	+	......	......	0	0	0	0	+	......
	12.00	....	6	641	2,600	130	30	......	0	0	0	0	+	......	......	0	0	0	0	+	......
	....	1.30	7	520	650	121	30	......	0	0	+	0	+	......	......	0	0	+	+	+	......
	....	2.00	8	720	4,800	190	30	......	0	0	+	0	+	......	......	0	0	0	+	+	......
	....	2.30	9	480	2,200	240	30	......	0	+	0	0	+	......	......	0	0	0	0	+	......
	....	3.00	10	360	850	220	120	......	0	0	0	0	+	......	......	0	0	+	0	+	......
January 27	10.00	....	1	950	180	650	480	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	10.30	....	2	490	2,800	370	1,200	......	0	0	+	+	+	......	......	0	+	+	+	+	......
	11.00	....	3	330	190	410	2,000	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	11.30	....	4	440	20	560	320	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	12.00	....	5	210	60	450	380	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	....	2.00	6	520	950	420	190	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	....	2.30	7	210	80	60	30	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	....	3.15	8	160	560	30	110	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	....	3.45	9	380	530	40	140	......	+	0	+	+	+	......	......	0	0	+	+	+	......
	....	4.15	10	0	40	70	100	......	0	0	+	+	+	......	......	0	0	+	+	+	......
January 28	10.00	....	1	200	4,600	30	240	......	0	0	0	+	+	......	......	0	0	0	+	+	......
	10.30	....	2	1,150	3,200	10	20	......	0	0	0	+	+	......	......	0	0	+	+	+	......
	11.00	....	3	180	1,200	20	290	......	0	0	0	0	+	......	......	0	0	0	0	+	......
	11.30	....	4	530	1,050	80	50	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	12.00	....	5	480	880	170	20	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	....	12.30	6	600	880	100	50	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	....	1.00	7	870	2,100	310	20	......	0	0	+	+	+	......	......	0	+	+	+	+	......
	....	1.30	8	1,100	680	250	20	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	2.00	9	1,500	860	340	90	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	....	2.36	10	1,150	1,000	460	340	......	0	+	+	+	+	......	......	0	+	+	+	+	......
January 29	9.00	....	1	0	460	10	10	......	0	+	0	+	+	......	......	0	0	+	+	+	......
	9.30	....	2	20	40	30	20	......	0	0	0	+	+	......	......	0	0	0	0	+	......
	10.00	....	3	10	360	0	30	......	0	0	+	0	+	......	......	0	0	+	+	+	......
	10.30	....	4	30	230	10	70	......	0	0	0	0	0	......	......	0	0	+	+	+	......
	11.00	....	5	0	90	0	30	......	0	0	0	0	0	......	......	0	0	+	+	+	......
	11.30	....	6	40	310	0	20	......	0	0	0	0	0	......	......	0	0	+	+	+	......
	12.00	....	7	20	190	20	10	......	0	0	0	0	0	......	......	0	0	+	+	+	......
	....	1.00	8	50	0	40	0	......	0	0	0	0	0	......	......	0	0	+	+	+	......
	....	1.30	9	20	40	10	40	......	0	0	0	0	0	......	......	0	+	+	+	+	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE SLOW SAND FILTER.

(Operating at rate of 5,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
				18°-22° C.		37° C.		Influent.							Effluent.						
	A.M.	P.M.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1911																					
January 29	....	2.00	10	30	10	0	150	......	0	0	0	0	0	......	......	0	0	0	+	+	......
January 30	9.00	....	1	580	4,750	20	90	......	0	0	0	0	+	......	......	0	0	+	+	+	......
	9.30	....	2	910	4,400	30	150	......	0	0	0	+	+	......	......	0	0	+	+	+	......
	10.00	....	3	760	2,600	120	110	......	0	0	+	+	+	......	......	0	0	0	+	+	......
	10.30	....	4	370	3,200	50	70	......	0	0	+	+	+	......	......	+	0	+	+	+	......
	11.00	....	5	310	340	90	50	......	0	+	+	+	+	......	......	0	+	0	+	+	......
	11.30	....	6	260	740	110	90	......	0	+	+	+	+	......	......	0	0	0	+	+	......
	12.00	....	7	230	140	170	10	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	1.00	8	60	10	110	20	......	0	0	+	+	+	......	......	0	+	+	+	+	......
	....	1.30	9	200	160	220	0	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	2.00	10	130	40	90	10	......	0	+	+	+	+	......	......	0	+	+	+	+	......
February 2	10.00	....	1	530	2,000	700	60	......	0	0	0	0	+	......	......	0	+	+	+	+	......
	10.30	....	2	390	1,200	950	40	......	0	0	0	+	+	......	......	0	0	0	+	+	......
	11.00	....	3	1,000	1,700	910	0	......	0	+	+	+	+	......	......	0	0	0	+	+	......
	11.30	....	4	1,200	550	1,000	60	......	0	+	+	+	+	......	......	0	0	0	0	+	......
	12.00	....	5	1,400	400	590	70	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	12.30	6	2,000	510	10	20	......	+	+	+	+	+	......	......	0	0	0	+	+	......
	....	1.00	7	2,000	140	20	10	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	1.30	8	2,600	520	170	40	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	2.00	9	1,400	110	210	10	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	....	2.30	10	1,550	70	220	70	......	+	+	+	+	+	......	......	0	0	0	+	+	......
February 4	9.15	....	1	40	40	0	10	......	0	0	0	0	0	......	......	0	0	0	0	0	......
	9.45	....	2	30	60	10	40	......	0	0	0	0	0	......	......	0	0	0	0	0	......
	10.15	....	3	60	10	60	40	......	0	0	0	+	+	......	......	0	0	0	+	+	......
February 5	9.00	....	1	700	1,400	0	10	......	0	0	0	0	+	......	......	0	0	+	+	+	......
	9.30	....	2	370	1,800	30	90	......	0	0	0	+	+	......	......	0	0	+	+	+	......
	10.00	....	3	180	280	160	30	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.30	....	4	640	470	210	120	......	0	+	+	+	+	......	......	0	0	0	+	+	......
	11.00	....	5	370	30	210	30	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	11.30	....	6	570	1,100	170	90	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	12.00	....	7	700	490	190	20	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	....	1.00	8	370	280	160	20	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	....	1.30	9	850	120	190	410	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	2.00	10	240	40	90	70	......	0	0	+	+	+	......	......	0	0	+	+	+	......
February 6	9.00	....	1	70	60	60	80	......	0	0	0	+	+	......	......	0	+	+	+	+	......
	9.30	....	2	70	40	100	70	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.00	....	3	40	0	190	60	......	0	0	+	+	+	......	......	0	+	+	+	+	......
	10.30	....	4	20	30	130	40	......	0	0	+	+	+	......	......	0	0	+	+	+	......

OPERATING DATA

THE SLOW SAND FILTER.

Date.	Hour. A.M.	Hour. P.M.	Serial No.	Bacterial Counts. 18°–22° C. Inf	18°–22° C. Eff	37° C. Inf.	37° C. Eff.	Colon Bacilli. Influent. .001 c.c.	Influent .01 c.c.	Influent .1 c.c.	Influent 1 c.c.	Influent 5 c.c.	Influent 25 c.c.	Influent 50 c.c.	Effluent. .001 c.c.	Effluent .01 c.c.	Effluent .1 c.c.	Effluent 1 c.c.	Effluent 5 c.c.	Effluent 25 c.c.	Effluent 50 c.c.
								0 = negative reaction										+ = positive reaction			
1914																					
February 6	11.00	....	5	0	0	170	290	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	11.30	....	6	250	10	90	40	......	0	0	+	+	+	......	......	0	+	0	+	+	......
	12.00	....	7	210	20	380	0	......	0	+	+	+	+	......	......	0	+	+	+	+	......
	....	1.00	8	180	30	190	20	......		+	+	+	+	......	......	0	0	+	+	+	......
	....	1.30	9	50	10	320	30	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	2.00	10	0	20	60	10	......	0	0	+	+	+	......	......	0	+	+	+	+	......
February 13	10.30	....	1	40	50	30	30	......	......	0	0	0	0	0	......	0	0	0	0	+	......
	11.00	....	2	850	110	40	30	......	......	0	0	0	0	0	......	0	0	+	0	+	......
	11.30	....	3	2,400	140	10	20	......	......	0	0	0	0	0	......	0	0	0	+	+	......
	12.00	....	4	630	310	80	20	......	......	0	0	0	0	0	......	0	0	+	+	+	......
	....	12.30	5	2,800	3,200	20	0	......	......	0	0	0	0		......	0	0	0	0	+	......
	....	1.00	6	850	700	10	20	......	......	0	0	0	0	0	......	0	0	0	+	+	......
	....	1.30	7	9,100	260	10	70	......	......	0	0	0	0	+	......	0	0	+	+	+	......
	....	2.00	8	1,400	420	10	20	......	......	0	0	0	0	0	......	0	0	+	+	+	......
	....	2.33	9	1,400	240	20	30	......	......	0	0	0	0	0	......	0	0	0	+	+	......
	....	3.00	10	1,600	6,400	30	10	......	......	0	0	0	0	0	......	0	0	+	+	+	......
Februar 16	10.15	....	1	950	140	1,300	40	......	0	+	+	+	+	......	0	+	+	+	+	......	......
	10.45	....	2	7,200	190	1,950	60	......	0	+	+	+	+	......	0	0	+	+	+	......	......
	11.45	....	3	6,400	290	1,200	10	......	0	+	+	+	+	......	0	0	+	+	+	......	......
	....	12.15	4	2,200	230	900	70	......	0	0	+	+	+	......	0	0	+	+	+	......	......
	....	12.45	5	2,800	140	400	50	......	0	+	+	+	+	......	0	+	+	+	+	......	......
	....	1.45	6	1,600	430	710	40	......	+	+	+	+	+	......	0	0	+	+	+	......	......
February 17	10.00	....	1	290	170	20	0	......	0	0	0	+	+	......	......	0	0	+	+	+	......
	10.30	....	2	190	200	80	30	......	0	0	0	+	+	......	......	0	0	+	+	+	......
	11.00	....	3	350	170	360	20	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	11.30	....	4	20	150	40	0	......	0	0	0	+	+	......	......	0	+	+	+	+	......
	12.00	....	5	950	130	1,100	0	......	0	+	+	+	+	......	......	0	0	0	+	+	......
	....	12.30	6	3,000	360	1,200	10	......	0	+	+	+	+	......	......	0	0	0	+	+	......
	....	1.00	7	2,300	170	750	10	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	....	1.30	8	1,950	150	900	50	......	+	+	+	+	+	......	......	0	+	+	+	+	......
	....	2.00	9	2,400	120	900	10	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	2.30	10	1,300	30	1,100	30	......	+	+	+	+	+	......	......	0	+	+	+	+	......
February 18	9.15	....	1	140	50	700	100	......	0	0	0	+	+	......	......	0	0	+	+	+	......
	10.00	....	2	510	180	500	50	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.30	....	3	1,400	120	850	20	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	11.00	....	4	1,800	30	550	30	......	+	0	+	+	+	......	......	0	0	+	+	+	......
	11.30	....	5	2,800	320	1,150	30	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	12.00	....	6	1,800	50	120	30	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	....	12.30	7	2,200	220	320	30	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	1.00	8	1,300	240	630	0	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	....	1.30	9	2,200	560	780	80	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	2.00	10	1,400	620	620	60	......	0	+	+	+	+	......	......	0	+	+	+	+	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE SLOW SAND FILTER.

(Operating at rate of 5,000,000 Imp. gals. per acre per day)

Date.	Hour A.M.	Hour P.M.	Serial No.	Bacterial Counts 18°–22° C. Inf.	Bacterial Counts 18°–22° C. Eff.	Bacterial Counts 37° C. Inf.	Bacterial Counts 37° C. Eff.	Colon Bacilli (0 = negative reaction; + = positive reaction) Influent .001 c.c.	Influent .01 c.c.	Influent .1 c.c.	Influent 1 c.c.	Influent 5 c.c.	Influent 25 c.c.	Influent 50 c.c.	Effluent .001 c.c.	Effluent .01 c.c.	Effluent .1 c.c.	Effluent 1 c.c.	Effluent 5 c.c.	Effluent 25 c.c.	Effluent 50 c.c.
1914																					
February 19	9.00	....	1	1,800	210	900	90	......	0	0	0	+	+	......	......	0	0	+	+	+	......
	9.45	....	2	2,400	290	1,900	30	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.15	....	3	2,600	110	1,700	60	......	0		+	+	+	......	......	0	0	+	+	+	......
	10.45	....	4	2,800	210	1,200	20	......	0		+	+	+	......	......	0	0	+	+	+	......
	11.15	....	5	1,950	40	1,400	10	......	0	0	+	+	+	......	......	0	+	+	+	+	......
	11.45	....	6	5,800	70	1,800	40	......	0		+	+	+	......	......	0	0	+	+	+	......
	....	12.15	7	4,000	290	1,550	60	......	0		+	+	+	......	......	0	0	0	+	+	......
	....	12.45	8	2,800	40	850	30	......	+		+	+	+	......	......	0	0	0	+	+	......
	....	1.15	9	1,600	30	340	20	......	0		+	+	+	......	......		+	+	+	+	......
	....	1.45	10	1,600	80	440	20	......	0		+	+	+	......	......	0		+	+	+	......
February 23	11.30	....	1	4,800	1,100	3,300	120	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	12.00	....	2	7,200	8,800	1,700	1,800	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	....	12.30	3	6,000	1,800	650	370	......	0		+	+	+	......	......	0	0	+	+	+	......
	....	1.00	4	7,600	750	650	90	......	0		+	+	+	......	......	0	0	+	+	+	......
	....	1.30	5	5,400	2,600	1,600	20	......	0		+	+	+	......	......	0	+	+	+	+	......
	....	2.00	6	5,100	2,400	400	70	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	....	2.30	7	9,600	1,800	450	90	......	0	0	+	+	+	......	......	0	0	0	+	+	......
	....	3.00	8	8,800	2,100	1,200	150	......	0		+	+	+	......	......	0	0	0	+	+	......
	....	3.30	9	7,600	1,400	2,200	220	......	0	0	+	+	+	......	......			+	+	+	......
	....	4.00	10	7,600	1,200	1,200	70	......	+	0	+	+	+	......	......	0	+	+	+	+	......
February 24	9.00	....	1	370	190	60	40	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.00	....	2	340	180	120	20	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	10.30	....	3	70	350	50	60	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	11.00	....	4	40	280	40	120	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	11.30	....	5	30	80	110	70	......	0		+	+	+	......	......	0	0	+	+	+	......
	12.00	....	6	180	130	440	50	......	0	0	+	+	+	......	......	0	+	+	+	+	......
	....	12.30	7	120	130	170	10	......	0	0	0	+	+	......	......	0		+	+	+	......
	....	1.00	8	110	70	190	30	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	....	1.30	9	40	20	40	10	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	....	2.00	10	60	0	90	20	......	0		+	+	+	......	......	0	0	+	+	+	......
February 25	10.30	....	1	1,200	620	40	40	......	0	0	+	+	+	......	......	0	0	0	+	+	......
	11.00	....	2	2,400	1,300	700	20	......	0		+	+	+	......	......	0	0	0	+	+	......
	11.30	....	3	2,400	310	950	60	......	0	0	+	+	+	......	......	0	0	0	+	+	......
	12.00	....	4	2,200	240	720	120	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	....	12.00	5	2,100	40	340	70	......	0	+	+	+	+	......	......	0		+	+	+	......
	....	1.00	6	3,800	530	550	50	......		+	+	+	+	......	......	0	0	+	+	+	......
	....	1.30	7	550	110	160	10	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	....	2.00	8	850	90	140	30	......		+	+	+	+	......	......	0	0	+	+	+	......

OPERATING DATA

THE SLOW SAND FILTER.

Date.	Hour.		Serial No.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
				18°–22° C		37° C		Influent.							Effluent.						
	A.M.	P.M.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
February 25	....	2.30	9	2,000	110	460	10	......	+	+	+	+	+	......	......	0	0	+	+	+	......
	....	3.00	10	390	30	90	20	......	0	+	+	+	+	......	......	0	0	+	+	+	......
February 26	9.30	....	1	1,400	100	850	20	......		+	+	+	+	......	......	0	+	+	+	+	......
	10.00	....	2	1,100	90	830	30	......	0	+	+	+	+	......	......	0	+	0	+	+	......
	10.30	....	3	80	90	30	30	......	0	0	+	+	+	......	......	0	0	+	+	+	......
	11.00	....	4	1,200	80	670	30	......	0	+	+	+	+	......	......	0	0	+	+	+	......
	11.30	....	5	1,200	60	230	10	......	0	+	+	+	+	......	......	0	0	+	+	+	......
February 27	9.00	....	1	1,000	330	410	30	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	9.30	....	2	1,600	1,600	320	0	......	0	0	+	+	......	......	......	0	+	+	+	+	......
	10.00	....	3	1,300	370	780	10	......	0	0	+	+	......	......	......	0	0	+	+	+	......
	10.30	....	4	1,200	300	560	80	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	11.00	....	5	1,300	330	3,600	550	......	0	+	+	+	......	......	......	+	+	+	+	+	......
	11.30	....	6	1,250	370	360	10	......	0	0	+	+	......	......	......	0	0	+	+	+	......
	12.00	....	7	1,100	160	420	40	......	0	0	+	+	......	......	......	0	+	+	+	+	......
	....	12.30	8	160	150	610	30	......	0	0	+	+	......	......	......	0	+	+	+	+	......
	....	1.00	9	1,150	160	130	80	......	0	0	+	+	......	......	......	0	0	+	+	+	......
	....	1.30	10	1,100	130	390	90	......	0	0	+	+	......	......	......	0	0	+	+	+	......
March 2	9.30	....	1	10	0	10	10	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	10.00	....	2	40	0	0	0	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	10.30	....	3	280	40	20	20	......	0	0	0	0	......	......	......	0	0	+	+	+	......
	11.00	....	4	110	30	10	20	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	11.30	....	5	30	60	0	0	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	12.00	....	6	40	10	10	0	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	....	12.30	7	110	0	10	0	......	0	0	0	0	......	......	......	0	0	+	+	+	......
	....	1.00	8	20	0	0	10	......	0	0	0	0	......	......	......	0	0	0			......
	....	1.30	9	30	10	0	10	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	....	2.00	10	170	10	10	0	......	0	0	0	+	......	......	......	0	0	+	+	+	......
March 3	9.15	....	1	110	90	30	0	......	0	0	0	+	......	......	......	0	0	0	+	+	......
	9.45	....	2	290	30	260	0	......	0	0	+	+	......	......	......	0	0	0	+	+	......
	10.15	....	3	80	30	190	40	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	10.45	....	4	90	20	220	10	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	11.15	....	5	290	20	270	10	......	+	+	+	+	......	......	......	0	0	0	+	+	......
	11.45	....	6	120	40	950	30	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	....	12.15	7	340	20	620	30	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	....	12.45	8	260	30	410	50	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	....	1.15	9	190	20	320	10	......	+	+	+	+	......	......	......	0	0	0	+	+	......
	....	1.45	10	210	0	40	50	......	0	+	+	+	......	......	......	0	0	+	+	+	......
March 4	9.30	....	1	520	90	60	10	......	0	0	0	0	......	......	......	0	+	0	+	+	......
	10.00	....	2	290	70	160	20	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	10.30	....	3	610	40	140	0	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	11.00	....	4	260	60	110	0	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	11.30	....	5	110	40	60	10	......	0	0	0	0	......	......	......	0	0	0	0	+	......

PROVINCIAL BOARD OF HEALTH EXPERIMENTAL STATION.

OPERATING DATA

THE SLOW SAND FILTER.

(Operating at rate of 5,000,000 Imp. gals. per acre per day)

Date.	Hour.		Serial No.	Bacterial Counts.				Colon Bacilli. 0 = negative reaction + = positive reaction													
				18°-22° C.		37° C		Influent.							Effluent.						
	A.M.	P.M.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																					
March 4	12.00	....	6	290	40	40	20	......	0	0	0	0	......	......	......	0	0	0	0	+	......
	....	12.30	7	130	20	180	20	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	....	1.00	8	230	20	90	0	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	....	1.30	9	460	30	80	20	......	0	0	0	0	......	......	......	0	0	0	0	+	......
	....	2.00	10	230	100	100	20	......	0	0	0	0	......	......	......	0	0	0	0	+	......
March 5	9.30	....	1	460	90	1,200	10	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	10.00	....	2	2,850	40	2,100	10	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	10.30	....	3	9,600	70	2,400	30	......	+	+	+	+	......	......	......	0	0	+	+	+	......
	11.00	....	4	7,200	90	850	40	......	+	+	+	+	......	......	......	0	+	+	+	+	......
	* 11.30	....	5	1,400	10	1,300	10	......	+	+	+	+	......	......	......	0	0	+	+	+	......
March 9	10.45	....	1	490	120	240	80	......	0	0	0	+	......	......	......	0	0	0	+	+	......
	11.15	....	2	950	180	200	50	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	11.45	....	3	900	490	180	30	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	....	12.15	4	1,400	1,000	300	20	......	0	0	0	0	......	......	......	0	0	0	+	+	......
	....	12.45	5	1,100	2,300	190	60	......	0	0	0	0	......	......	......	0	0	+	+	+	......
	....	1.15	6	480	1,050	110	80	......	0	0	0	0	......	......	......	0	0	+	+	+	......
	....	1.45	7	560	470	90	10	......	0	0	0	0	......	......	......	0	0	0	0	+	......
	....	2.15	8	20	830	30	20	......	0	0	0	0	......	......	......	0	0	0	0	+	......
	....	2.45	9	780	900	50	40	......	0	0	0	+	......	......	......	0	0	+	+	+	......
	....	3.15	10	1,500	1,200	430	40	......	0	0	0	+	......	......	......	0	0	0	0	+	......
March 10	9.00	....	1	750	870	10	20	......	0	0	0	0	......	......	......	0	0	0	0	+	......
	9.30	....	2	10	800	10	10	......	0	0	0	+	......	......	......	0	+	0	0	+	......
	10.00	....	3	50	650	10	0	......	0	0	+	+	......	......	......	0	+	0	0	+	......
	10.30	....	4	180	380	0	10	......	0	0	0	+	......	......	......	0	0	0	+	+	......
	11.00	....	5	30	110	10	0	......	0	0	0	+	......	......	......	0	0	0	+	+	......
March 11	....	3.20	1	3,800	140	1,600	80	......	0	+	+	+	......	......	......	0	+	+	+	+	......
March 12	11.00	....	1	1,200	60	550	70	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	....	1.40	2	550	40	290	50	......	0	+	+	+	......	......	......	0	0	+	+	+	......
March 13	11.00	....	1	370	630	50	80	......	0	0	0	+	......	......	......	0	0	0	+	+	......
	....	2.00	2	1,400	0	720	0	......	0	+	+	+	......	......	......	0	0	+	+	+	......
March 17	11.00	....	1	2,400	120	850	40	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	....	3.00	2	2,600	340	1,650	20	......	+	+	+	+	......	......	......	0	+	+	+	+	......
March 18	10.00	....	1	1,600	0	670	20	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	....	3.00	2	620	40	950	30	......	0	+	+	+	......	......	......	0	0	+	+	+	......
March 19	10.00	....	1	4,200	110	950	120	......	0	+	+	+	......	......	......	0	0	+	+	+	......
March 24	10.00	....	1	260	40	170	20	......	0	0	+	+	......	......	......	0	0	0	0	+	......
	....	3.00	2	16,000	40	550	10	......	+	+	+	+	......	......	......	0	0	+	+	+	......

*Head lost.

OPERATING DATA

The Slow Sand Filter.

Date.	Hour.		Serial No.	Bacterial Counts.				Colon Bacilli. 0=negative reaction +=positive reaction													
				18°-22° C.		37° C.		Influent.							Effluent.						
	A.M.	P.M.		Inf.	Eff.	Inf.	Eff.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.	.001 c.c.	.01 c.c.	.1 c.c.	1 c.c.	5 c.c.	25 c.c.	50 c.c.
1914																					
March 25	10.00	....	1	1,600	7	1,520	13	......	0	+	+	+	......	......	......	0	0	0	+	+	......
	....	3.00	2	1,600	18	780	11	......	0	+	+	+	......	......	......	0	+	+	+	+	......
March 26	10.00	....	1	760	6	680	5	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	....	3.00	2	720	5	290	6	......	+	+	+	+	......	......	......	0	0	+	+	+	......
March 27	10.00	....	1	1,520	5	160	4	......	0	+	+	+	......	......	......	0	0	+	+	+	......
	....	2.00	2	840	9	220	2	......	0	+	+	+	......	......	......	0	0	+	+	+	......
March 31	10.00	....	Head lost	....	....	....	....	......	......	......	......	......	......	......	......	......	......	......	......	......	......
April 1	10.00	....	1	2,200	95	1,280	10	......	+	+	+	+	......	......	......	0	0	0	+	+	......
	....	3.00	2	2,200	22	1,600	4	......	+	+	+	+	......	......	......	0	0	0	+	+	......
April 2	10.00	....	1	1,900	18	80	6	......	+	+	+	+	......	......	......	0	0	0	+	+	......
	....	3.00	2	2,600	12	1,200	4	......	+	+	+	+	......	......	......	0	+	0	+	+	......
April 7	10.00	....	1	5,200	80	6,000	30	......	+	+	+	+	......	......	......	0	0	0	+	+	......
	....	2.00	2	5,600	50	7,200	20	......	+	+	+	+	......	......	......	0	0	+	+	+	......

STUDIES IN THE DISINFECTION OF SEWAGE WITH CALCIUM HYPOCHLORITE.

C. R. Avery, B.A.Sc.

Introduction.

Although of comparatively recent discovery, chlorine is to-day one of the most important economic elements, entering, as it does, into numerous compounds of the industrial world, besides the prominent part it now takes in the field of sanitation. In the latter field its use on a commercial basis dates back very few years, although isolated instances are known of its use as a disinfectant during the early part of the nineteenth century; these occasions were generally confined to the fields of experiment and research. It was not until the year 1810 that Sir Humphrey Davy definitely showed that chlorine was an element and not a compound, and it is due to him that it received its name from the Greek word chloras, meaning light green.

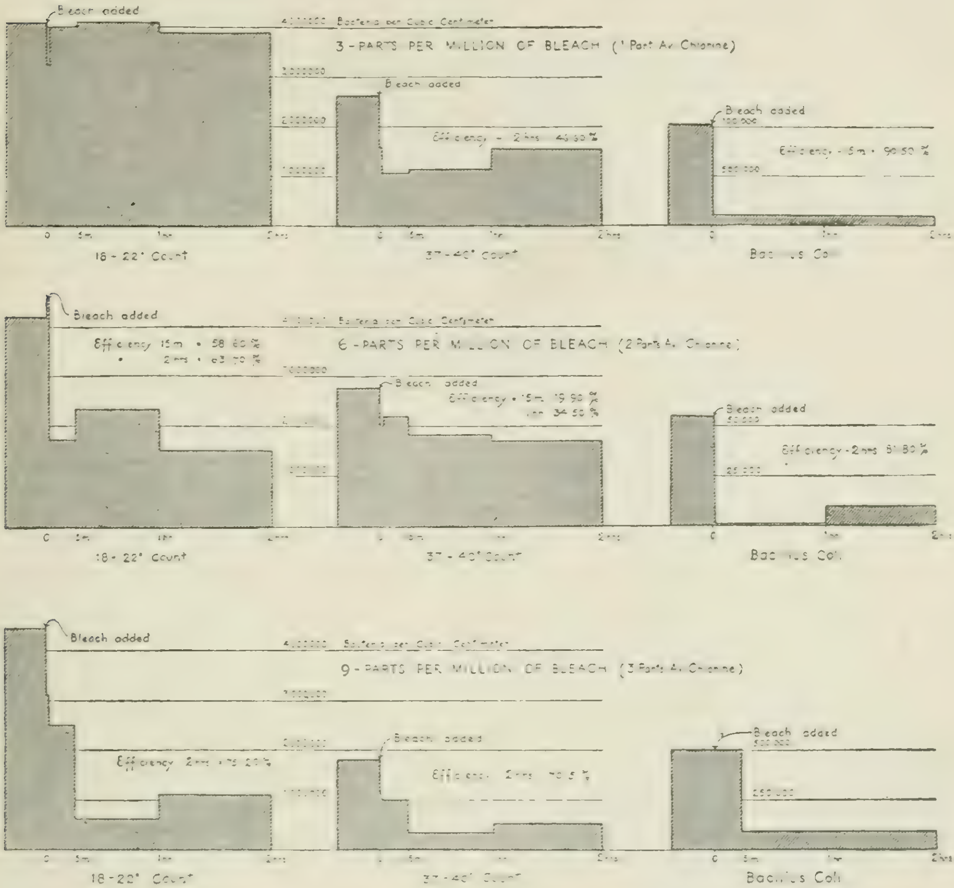
The use of chlorine as a bleaching agent began about the end of the eighteenth century, but at that time it was an expensive process, and more than one manufacturer had severe losses due to the chlorine attacking the linen fibre. About this time Dr. Henry took hold of the problem, and after twelve years of diligent work succeeded in converting the chlorine gas into the dry and useful form commercially called chloride of lime or bleaching powder, by combining it with slaked lime. This form ordinarily contains from 30 to 38 per cent. of available chlorine

The production of calcium hypochlorite or chloride of lime has increased with enormous strides in America during the last few years, and to-day it can be delivered in carload lots at a cost of about 1 1-3 cents per lb., and containing seldom less than 33 per cent. of available chlorine.

One only needs to delve into the mass of results and information which has been published regarding the germicidal action of chloride of lime in order to realize that it is one of the most powerful chemical disinfecting agents known, and also that it is one of the cheapest. It seems almost incredible that less than two cents' worth (1lb. of chloride of lime) will practically sterilize 1,600 gallons of strong sewage, or that six dollars' worth will completely sterilize one million gallons of strong sewage if its action be prolonged two hours. In the case of cities having a daily discharge of over 10,000,000 gallons of sewage this necessarily amounts to a considerable annual expenditure. Fortunately the effluents from sedimentation tanks and sewage disposal works do not require absolute sterilization. Disinfection, that is, the removal of pathogenic organisms, can be effected with but a portion of the amount necessary to produce sterilization.

Let us consider a city of 100,000 population discharging 125 gallons of sewage per capita per day, which is no doubt a rather high rate. The daily average discharge then would be 12,500,000 gallons. If we treat this with 8 parts per million of available chlorine we should get a fairly high degree of disinfection (see experiment on page 193). These 12,500,000 gallons would require 3,000 lbs. of bleach. The daily cost would be $3,000 \times 1\frac{1}{3} = \$10.00$ and the annual cost would be \$14,600.00 plus labour, say \$2,000 . . . the total annual cost would be \$16,600 and the per capita \$0.166 or about 16½ cents. The total per capita cost of a sewerage system and disposal plant is usually from \$15 to \$25 and the annual maintenance charges from \$1 to \$1.50. The use of chloride of lime would only increase this maintenance charge by about 16½ cents. To realize the advantages

DISINFECTION OF SEWAGE



Disinfection of Sewage
3 Parts per Million of Bleach (1 Part Av. Chlorine)

Interval after adding Bleach	Experiments	18-22° C Count	37-40° C Count	Bacillus Coli
Raw	7	4142000	[illegible]	[illegible]
1 Min.	7	[illegible]	[illegible]	[illegible]
15 "	7	[illegible]	[illegible]	[illegible]
1 hr.	5	[illegible]	[illegible]	[illegible]
2 "	–	[illegible]	[illegible]	[illegible]

Disinfection of Sewage
6 Parts per Million of Bleach (2 Parts Av. Chlorine)

Interval after adding Bleach	Experiments	18-22° C Count	37-40° C Count	Bacillus Coli
Raw	7	[illegible]	[illegible]	[illegible]
1 Min.	7	[illegible]	[illegible]	[illegible]
15 "	[illegible]	[illegible]	[illegible]	[illegible]
1 hr.	10	[illegible]	[illegible]	[illegible]
2 "	5	[illegible]	[illegible]	* [illegible]

Disinfection of Sewage
9 Parts per Million of Bleach (3 Parts Av. Chlorine)

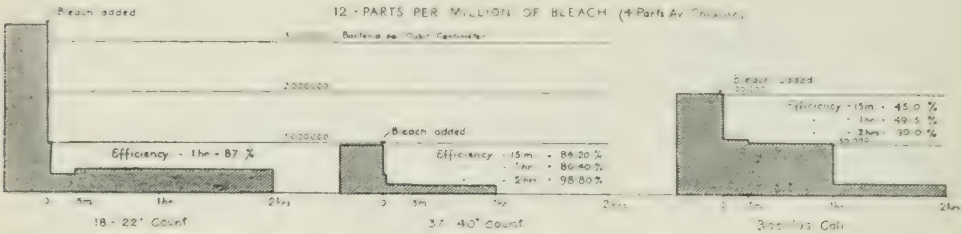
Interval after adding Bleach	Experiments	18-22° C Count	37-40° C Count	Bacillus Coli
Raw	6	[illegible]	[illegible]	–
1 Min.	7	[illegible]	[illegible]	–
15 "	9	[illegible]	[illegible]	[illegible]
1 hr.	[illegible]	[illegible]	3,400,000	[illegible]
2 "	5	[illegible]	[illegible]	[illegible]

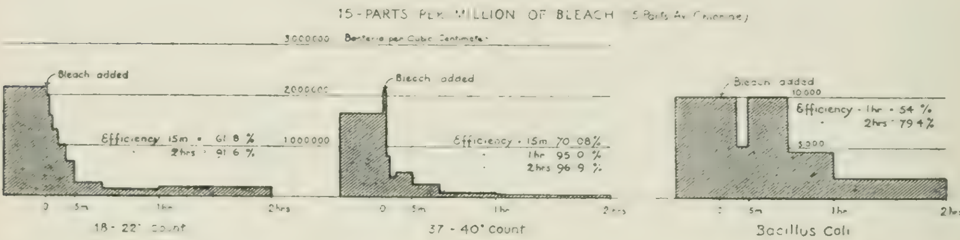
* After 2 hrs. B. Coli present in [illegible] C.C. while after 1 hour B. Coli only present in [illegible] C.C. of sewage. These [illegible] frequently noted, when using small quantities of bleach.

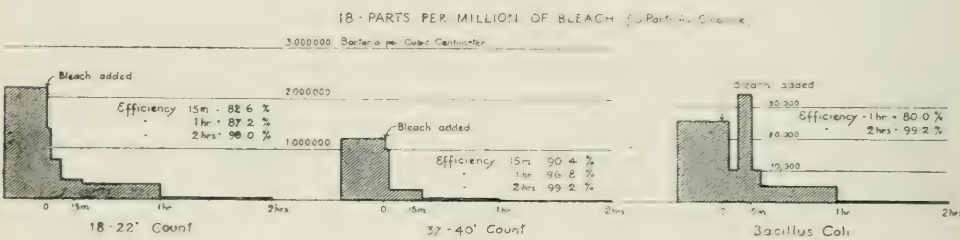
of modern methods of sewage collection one only has to recall the old-time system whereby each householder had to pay 50 cents per month for having the boxes or pails taken away and emptied.

There is no question about the ease of application of chloride of lime in large installations, it is usually mixed in large tanks and when settled may be titrated with sodium thiosulphate or arsenious oxide solutions to find its exact strength. From these tanks the clear solution is fed by means of calibrated orifices into the sewage, ample provision being made to insure its thorough mixture and contact with the undiluted sewage for 20 minutes.

DISINFECTION OF SEWAGE







Disinfection of Sewage
12 Parts per Million of Bleach (4 Parts Av Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	11	3,330,000	950,000	100,000
1 Min	11	970,000	350,000	100,000
15 -	11	390,000	150,000	55,000
1 Hr	11	460,000	130,000	50,500
2 -	11	460,000	11,000	10,000

Disinfection of Sewage
15 Parts per Million of Bleach (5 Parts Av Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	18	2 150 000	1 640 000	10,000
1 Min	9	2 000 000	2 100 000	10 000
3 -	9	1 580 000	800 000	10 000
6 -	9	1 300 000	360 000	10 000
10 -	4	1 050 000	—	10 000
15 -	16	820 000	480 000	5,050
30 -	4	250 000	240 000	10,000
1 Hr	19	143 000	83 000	4600
2 Hrs	14	176 000	50 000	2060

Disinfection of Sewage
18 Parts per Million of Bleach (6 Parts Av Chlorine)

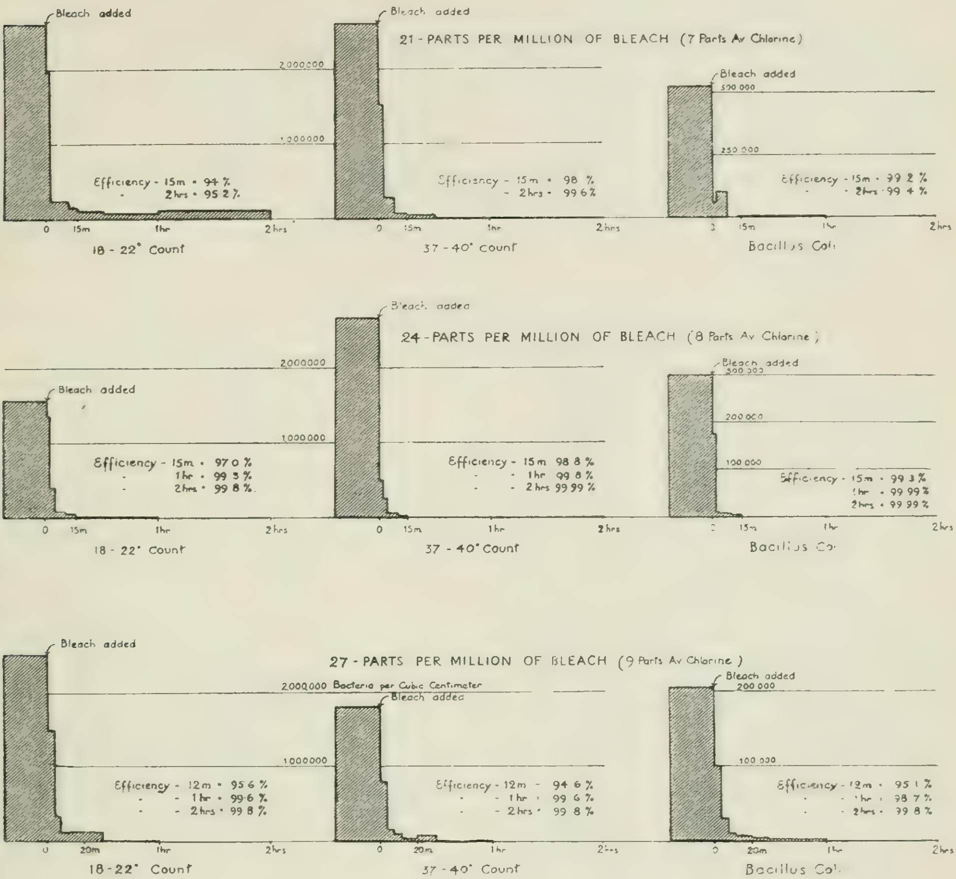
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	15	2 190 000	1 210 000	—
2 Min	17	1 380 000	970 000	25 400
8 -	7	780 000	210 000	10 000
15 -	11	380 000	115 000	*34 000
20 -	7	370 000	110 000	10 000
1 Hr	17	288 000	40 000	5 025
2 Hrs	15	40 600	10 000	400

* On Dec 22nd 1913 one sample was positive in a dilution of 1/100000 which caused the average for this interval to be raised

One of the greatest and most acute problems in sewage disposal is to produce an effluent which does not give rise to objectionable putrefaction. The addition of this chemical is in itself an aid in this direction, preventing immediate decomposition. Furthermore, it has been found as a result of experiments on the settling reservoirs of the Cincinnati Water Works that chloride of lime is a fairly efficient algicide, so that with its use one would not expect to be troubled with such luxuriant algae growths as are often noticed in the locality of sewer outlets.

The problem of sewage disposal must always be met individually with regard to each municipality. Obviously, cities discharging sewage into small streams have a more acute problem to deal with than those situated on large rivers or other bodies

DISINFECTION OF SEWAGE



Disinfection of Sewage 21 Parts per Million of Bleach (7 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18·22°C Count	37-40°C Count	Bacillus Coli
Raw	17	2600 000	2600,000	527.500
2 Min	17	1970000	1,520,000	55 000
10 -	7	230000	280 000	100 000
15 -	12	137.000	53 000	3700
30 -	7	111,300	45,400	5200
1 Hr	17	63,300	11,400	2752
2 Hrs	12	124 400	17200	3367

Disinfection of Sewage 24 Parts per Million of Bleach (8 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	14	1570000	2660000	303 000
2 Min.	14	1350000	545000	277 500
4 -	4	370000	290000	10 000
10 -	4	76 500	57000	5 500
15 -	9	48 200	21 000	3700
1 Hr	14	11200	3200	3 2
2 Hrs	14	2620	770	3 05

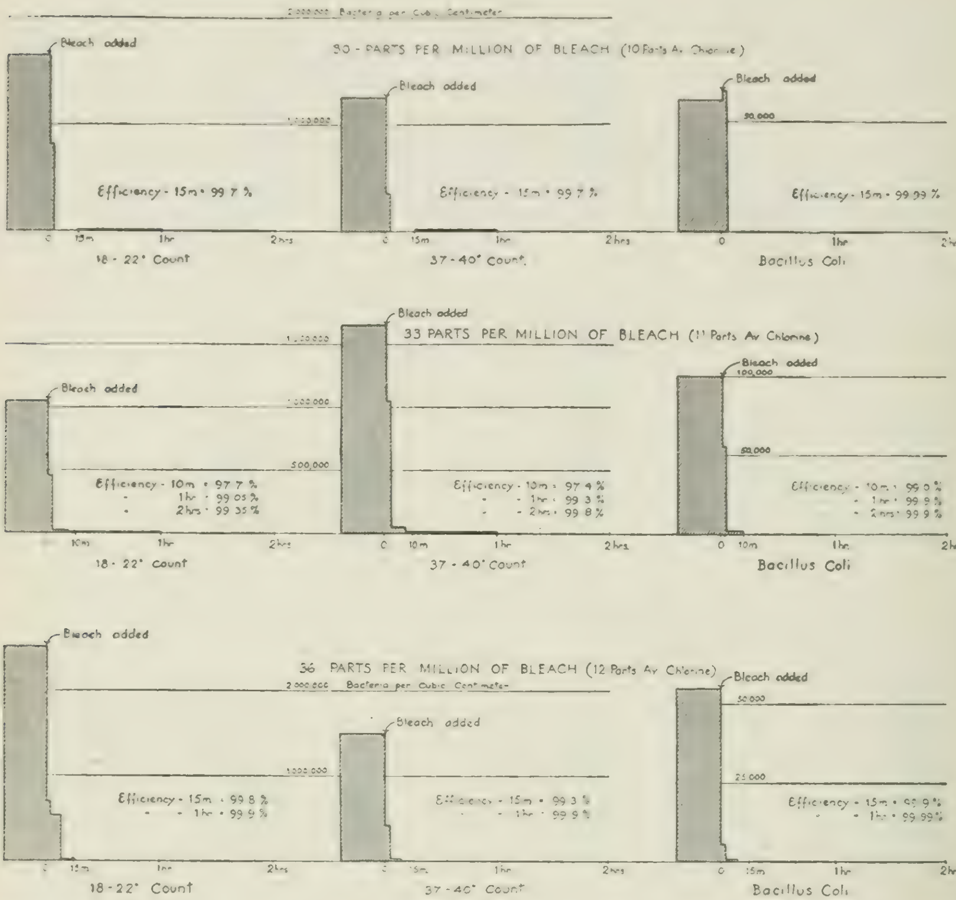
Disinfection of Sewage 27 Parts per Million of Bleach (9 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18·22°C Count	37-40°C Count	Bacillus Coli
Raw	18	2 500 000	1740 000	205 000
4 Min	8	1 550 000	797 000	100 000
8 -	8	340.000	147 000	30 000
12 -	6	111 000	93.800	10 000
20 -	6	129.000	37 000	7 000
30 -	6	136.000	85 900	4 000
1 Hr	6	9500	4.500	2,520
2 Hrs	6	5100	3240	275 3

of water, whether fresh or salt. In either case the ideal end to be reached is the same and that is to deliver an effluent not only non-putrescible but also free from pathogenic organisms. To what specific degree this end should be reached depends entirely on local conditions and in Ontario on any standard which it may be expedient for the Provincial Board of Health to set.

2. Character of the Report.

Since the treatment of sewage is one of the greatest problems we have to deal with to-day and since each community has to a more or less degree an individual problem to deal with, any information which will indicate with some degree of definiteness and reliability the effects of different amounts of chloride of lime

DISINFECTION OF SEWAGE



Disinfection of Sewage
30 Parts per Million of Bleach (10 Parts Av. Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	13	1670000 [?]	1250000	* 64000
2 Min	12	840000	360000	** 70000
15 "	7	5700	3000	10
1 Hr	12	8300	9500	5 5
2 Hrs	12	5,500	2,500	1

Disinfection of Sewage
33 Parts per Million of Bleach (11 Parts Av. Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	6	1050000	640000 [?]	100000
2 Min	7	465000 [?]	1102000 [?]	55000
10 "	6	24000	42000	1000
1 Hr	6	10000	10300 [?]	† 50 5
2 Hrs	5	6840	3500	100

Disinfection of Sewage
36 Parts per Million of Bleach (12 Parts Av. Chlorine)

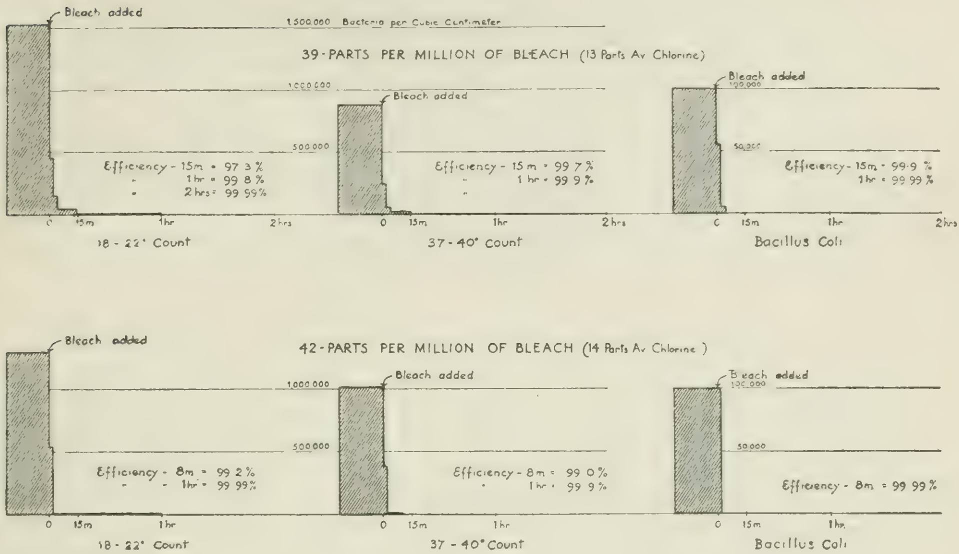
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	7	2500000	1500000 [?]	55000 [?]
2 Min	7	711000 [?]	[illegible]	5500 [?]
8 "	7	566000 [?]	[illegible]	1000
15 "	7	19100 [?]	9430 [?]	55
1 Hr	7	3130	1600	0 14
2 Hrs	7	150	120	0 2

* B Coli present in three 0.0001 CC samples out of five ** B Coli present in two 0.0001 CC samples out of three
† B Coli in one sample not present in less quantity than 1 CC raised the average

or any other moderately priced disinfectant on sewage and Imhoff and percolating filter effluents, will, no doubt, be appreciated by those engaged in solving this problem.

The following experiments were undertaken with the idea of finding out what might be expected from the use of chloride of lime for disinfection when dealing with the question on a large scale. Graphs have been plotted which will indicate its effect when applied to raw sewage and to the effluents of large units, such as Imhoff tanks, Septic tanks, Percolating filters, etc. The experiments are tabulated and plotted under the following heads:—

DISINFECTION OF SEWAGE



Disinfection of Sewage 39 Parts per Million of Bleach (13 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	7	1 530 000	930 000	100 000
2 Min	7	454 000	236 000	55 000
4 "	7	150 000	68 000	5 500
15 "	7	41 600	21 500	55
1 Hr	7	2 570	127	0 6
2 Hrs	7	60	110	0 55

Disinfection of Sewage 42 Parts per Million of Bleach (14 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	5	1,300,000	1.020 000	—
2 Min	5	536 000	374 000	100,000
8 "	5	10 900	10, 500	1
30 "	5	9 700	110	0 2
1 Hr	5	30	47	0 2

(*a*) Disinfection of Raw Sewage.
(*b*) " " Imhoff effluent.
(*c*) " " Septic effluent.
(*d*) " " Percolating filter effluent (coke).
(*e*) " " " " " (broken glass).
(*f*) " " " " " (" stone).

On page 213 a typical result sheet is shown for the complete bacteriological analyses of one sewage sample. As a rule three such examinations were made per day besides washing and sterilizing the used plates, tubes, etc.

Graphs illustrating the effectiveness of chloride of lime sterilization are shown beginning at page 191. Each of the graphs shown represents an average of from two to six complete analyses, each made on different days. It will be noticed that when using less than 5 parts of available chlorine with raw sewage the germicidal efficiencies are low and the graphs and results otherwise tend to be erratic and inconsistent at times. It is hard to say what causes these inconsistencies, one of which is noticed on page 192. In this graph, illustrating the action of 12 parts of Bleach, the hourly 18-20° count is greater than the count made only 15 minutes after chlorination. A plausible theory for the phenomena is, that the colonies,

clumps and groups of bacteria suspended throughout the sample of sewage and incorporated in the small masses of faecal matter become more and more broken up and disintegrated in consequence of successive shakings—just before plating—causing an increase in the count, this on occasions may more than offset the immediate decrease in count caused by the germicidal action of the chlorine. The frequency with which these irregularities occur when using small quantities of bleach seems to bear out this theory.

It will be noticed that high efficiencies were obtained when using 21 parts of bleach or when using 7 parts and over of available chlorine per million.

All experiments were conducted on an available chlorine basis, the results, for convenience, have been tabulated under the head of so many parts of bleach per million, assuming that ordinary bleach contains about 33.3 per cent. of available chlorine.

3. Bearing of this Report Upon Existing Data.

While a great deal of research has been done on the use of chloride of lime for treating sewage and water, it can hardly be said that the existing date is in a form that can be used by engineers or municipalities as a basis for estimating the probable amount of chloride of lime necessary for disinfecting a sewage. An individual investigation should always be recommended to determine the amount of chloride of lime necessary to obtain a required degree of disinfection, this unfortunately is not always possible and where possible is not always properly carried out. It is not only necessary to make bacteriological determinations after adding given amounts of chloride of lime, but in addition there are many other considerations of great importance, such as storage after chlorination, that must receive careful attention, for example, 5 parts of available chlorine if the sewage be given a sufficient storage after its addition would probably have the same effect as 9 or 10 parts with no storage whatsoever. The period of retention after chlorination is a very vital consideration, both from an efficiency standpoint and as a question in economics. In order to answer effectively this and other questions *the experiments were so arranged as to connect the character of the sewage and the amount of disinfectant required for various periods of retention.* The graphs and tables continued through the report were prepared to illustrate three essential features,

Character of sewage,
Quantity of disinfectant,
Effect of storage.

4. Results and Charts.

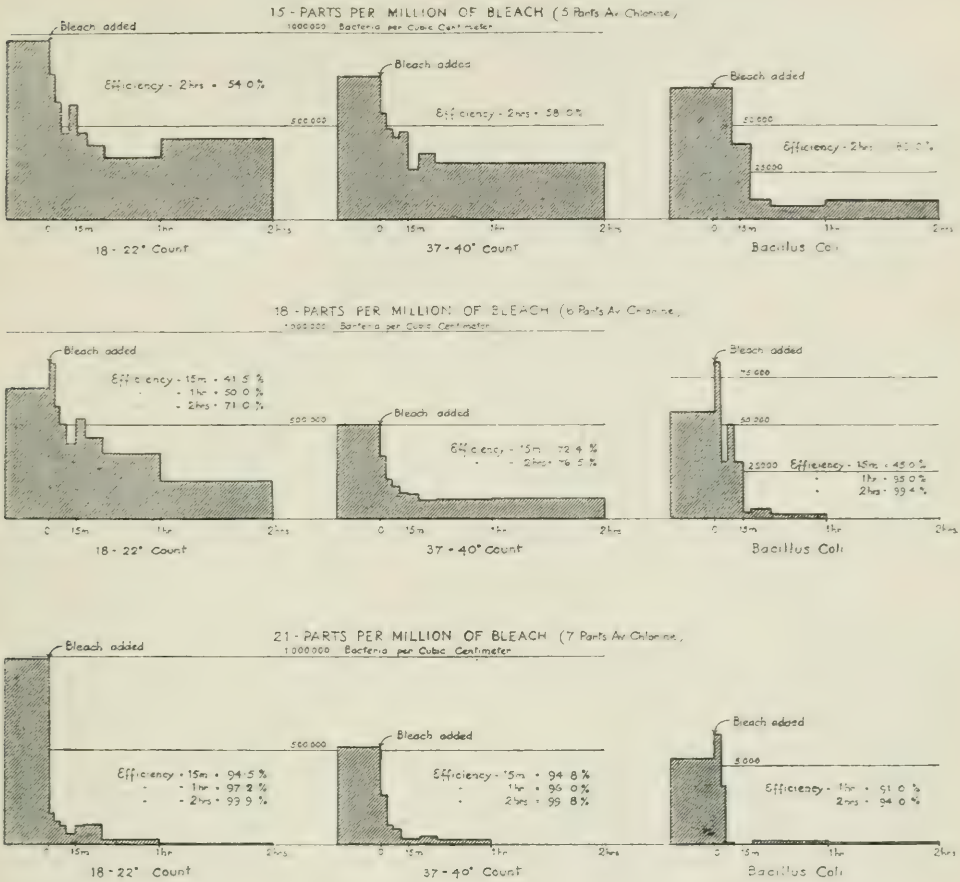
(*a*) *Disinfection of Raw Sewage by Chlorination.*

The number of bacteria in the untreated sample is represented by the dark portion between the left-hand side of the graph and the point marked O. The counts found at the different intervals after adding the bleach are represented by the subsequent dark portions.

Below the graphs are shown tabular summaries of the averages of results from which the graphs were plotted. The germicidal efficiencies of different amounts of chloride of lime for different intervals are shown on the graphs.

It will be noticed that the reduction in count following the addition of from one to three parts available chlorine per million is comparatively small and that

DISINFECTION OF IMHOFF EFFLUENT



Disinfection of Imhoff Effluent
15 Parts per Million of Bleach (5 parts Av. Chlorine)

Interval after adding Bleach	Experiments	18-22° C Count	37-40° C Count	Bacillus Coli
Raw	6	960 000	761 000	—
3 Min	6	781 000	560 000	—
6 "	4	640 000	490 000	—
10 "	6	438 000	443 000	70 000
15 "	6	623 000	465 000	40 000
20 "	6	468 000	266 000	40 000
30 "	6	413 000	353 000	10 000
1 Hr	6	343 000	320 000	7 000
2 Hrs	6	441 000	320 000	10.000

Disinfection of Imhoff Effluent
18 Parts per Million of Bleach (6 parts Av. Chlorine)

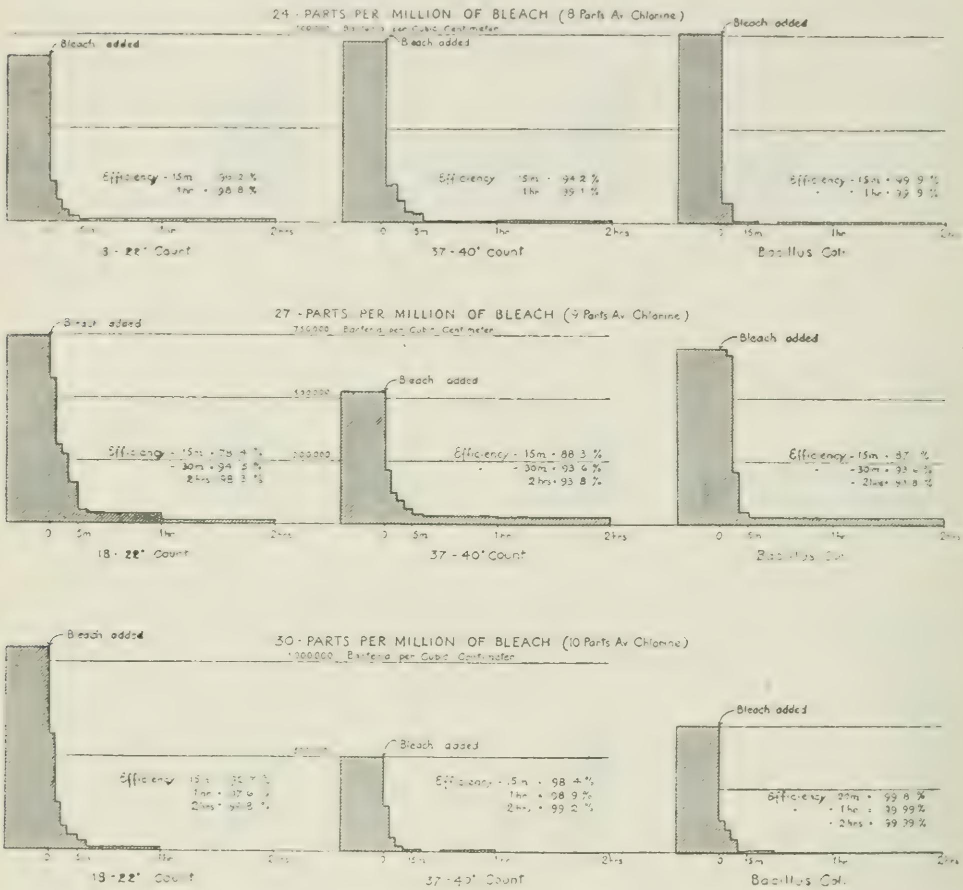
Interval after adding Bleach	Experiments	18-22° C Count	37-40° C Count	Bacillus Coli
Raw	6	700 000	496 000	55 000
3 Min	6	853 000	346 000	77 500
6 "	6	600 000	207 000	30 250
10 "	6	513 000	170 000	50.500
15 "	6	415 000	137 000	30 250
20 "	6	535 000	130 000	3.025
30 "	8	443 000	104 000	5 275
1 Hr	8	349 000	111 000	2.777
2 Hrs	8	245 000	116 000	280

Disinfection of Imhoff Effluent
21 Parts per Million of Bleach (7 parts Av. Chlorine)

Interval after adding Bleach	Experiments	18-22° C Count	37-40° C Count	Bacillus Coli
Raw	6	983 000	521 000	5 500
3 Min	4	160.000	260.000	7 000
6 "	6	120 000	96 000	3 700
10 "	4	105.000	80 000	300
15 "	6	55.000	27 000	100
20 "	6	99 000	28 000	55
30 "	6	103 000	40 000	505
1 Hr	6	28 400	20 600	500
2 Hrs	4	210	800	340

a really good efficiency is not procured until at least 46 parts of available chlorine are added. When using 18 parts per million of bleach (6 parts av. chlorine) the increase in efficiency with the storage interval is very marked. In general as the amount of bleach used increases the increase in efficiency with the storage interval rapidly becomes smaller. When using 8 parts of available chlorine per million the average efficiencies after storage periods of 15 minutes, 1 hour and 2 hours are respectively 98.3 per cent., 99.7 per cent. and 99.93 per cent. If the efficiency after 15 minutes is this high, it would not be economical to provide four times the storage capacity to secure the increased efficiency after a storage of 1 hour. In case a higher efficiency were required, it would be cheaper to increase slightly the amount of bleach added than to provide a larger storage capacity.

DISINFECTION OF IMHOFF EFFLUENT



Disinfection of Imhoff Effluent
24 Parts per Million of Bleach (8 Parts Av. Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	4	442 000	[illegible]	[illegible]
3 Min	4	[illegible]	97 600	[illegible]
6 "	4	58 000	107 000	[illegible]
10 "	4	[illegible]	59 000	[illegible]
15 "	4	17 000	28 500	[illegible]
20 "	4	4 000	25 000	[illegible]
30 "	4	3 000	4 000	* [illegible]
1 Hr	4	[illegible]	[illegible]	[illegible]
2 Hrs	4	[illegible]	[illegible]	[illegible]

Disinfection of Imhoff Effluent
27 Parts per Million of Bleach (9 Parts Av. Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	6	[illegible]	[illegible]	—
3 Min	6	[illegible]	216 000	70 000
6 "	6	308 000	[illegible]	[illegible]
10 "	6	[illegible]	[illegible]	21 000
15 "	6	[illegible]	[illegible]	[illegible]
20 "	4	[illegible]	[illegible]	3 400
30 "	4	[illegible]	[illegible]	3 700
1 Hr	4	[illegible]	[illegible]	[illegible]
2 Hrs	4	[illegible]	32 500	[illegible]

Disinfection of Imhoff Effluent
30 Parts per Million of Bleach (10 Parts Av. Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	6	1 076 000	[illegible]	40 000
3 Min	4	[illegible]	[illegible]	[illegible]
6 "	6	250 000	73 000	[illegible]
10 "	6	123 000	[illegible]	[illegible]
15 "	6	79 500	8 300	† [illegible]
20	6	47 300	[illegible]	[illegible]
30 "	6	27 000	3 700	[illegible]
1 Hr	6	26 000	5 700	[illegible]
2 Hrs	6	3 200	3 700	7

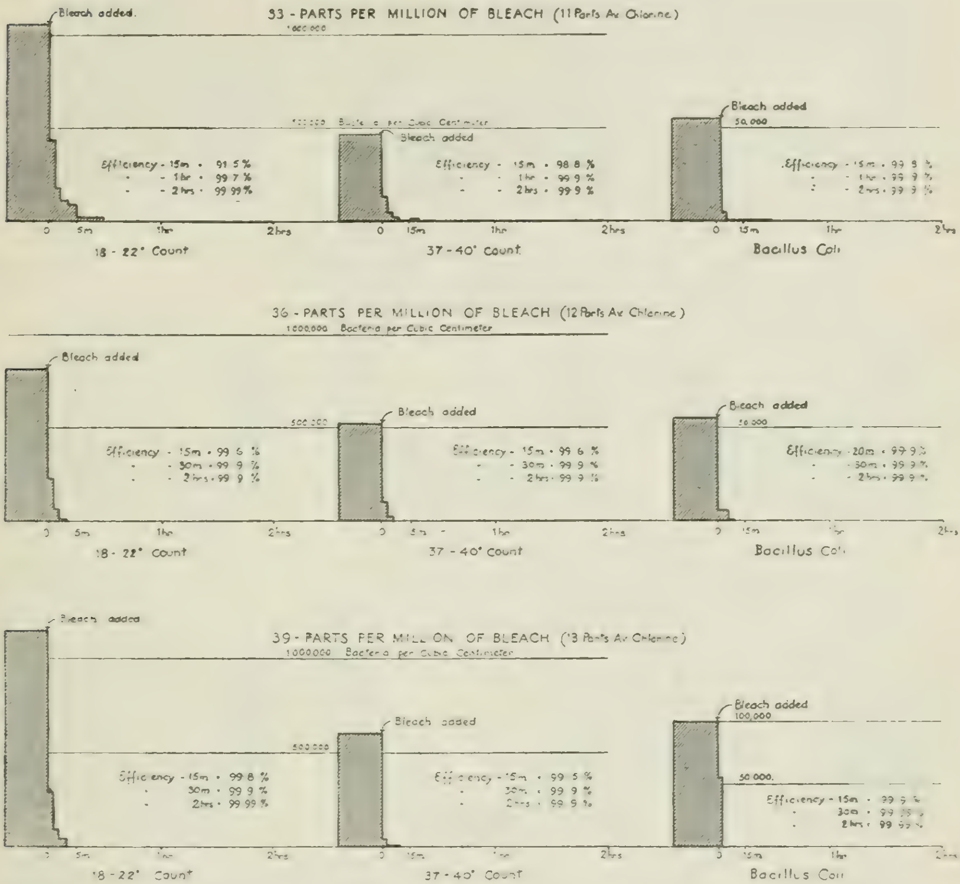
* One sample not positive in less than [illegible] quantity raised the average.
† No samples positive in less than [illegible] quantity [illegible] the next two periods each had one sample positive [illegible] quantity.

The abruptness with which the counts are reduced when using 8 and more parts of available chlorine per million is also worthy of note.

The graphs illustrating the action of 10 and more parts of available chlorine per million show a wonderful reduction in the number of bacteria after intervals of even less than 15 minutes.

All raw sewage samples were taken directly from the pump which supplies the Experimental plant with sewage from the Garrison Creek sewer and as this pump works intermittently at intervals of about three minutes the samples were either taken during the operation of the pump or immediately after it had stopped so as

DISINFECTION OF IMHOFF EFFLUENT



Disinfection of Imhoff Effluent 33 Parts per Million of Bleach (11 Parts Av. Chlorine)				
Interval after adding Bleach	Experiments	18 22° C Count	37-40° C Count	Bacillus Coli
Raw	4	[illegible]	472,500	—
3 Min	4	445 000	135 000	55 000
6 -	4	181 500	39 500	5,500
10 -	4	115 000	15 000	550
15 -	4	90 500	5 500	100
20 -	4	22 150	13 000	100
30 -	4	21 000	1 850	10
1 Hr	4	3 070	650	34
2 Hrs	3	480	340	0 6

Disinfection of Imhoff Effluent 36 Parts per Million of Bleach (12 Parts Av. Chlorine)				
Interval after adding Bleach	Experiments	18 - 22° C Count	37-40° C Count	Bacillus Coli
Raw	4	[illegible]	517 500	55 000
3 Min	4	[illegible]	82 000	5 500
6 -	4	62 500	25 000	5500
10 -	4	8 600	4 100	100
15 -	4	2 870	1 925	10
20 -	4	[illegible]	675	50·5
30 -	4	500	275	5·5
1 Hr	4	350	100	10
2 Hrs	4	425	110	55

Disinfection of Imhoff Effluent 39 Parts per Million of Bleach (13 Parts Av. Chlorine)				
Interval after adding Bleach	Experiments	18-22° C Count	37-40° C Count	Bacillus Coli
Raw	4	1,150 000	602 000	100 000
3 Min	4	250 000	44 000	55 000
6 -	4	95 000	13 000	550
10 -	4	45 700	15 750	550
15 -	4	2 300	2450	55
20 -	4	75	250	10
30 -	4	60	85	10
1 Hr	4	2	97	1
2 Hrs	4	6	50	55

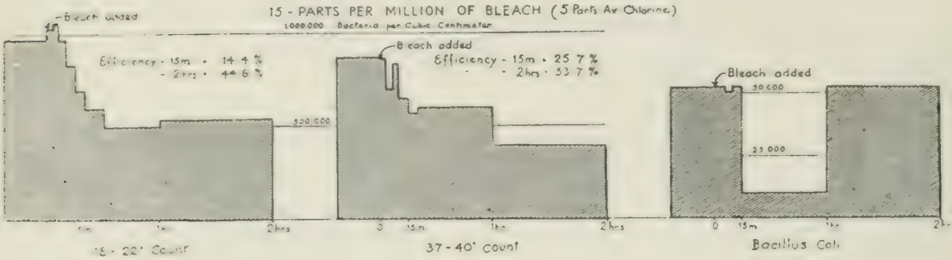
to allow the sewage no interval in which the suspended solids could settle. After plating a sample from this raw sewage it was then treated with a pre-determined quantity of the standard chlorine solution and samples then plated at different intervals to determine the effect of the chloride of lime on the bacteria.

(b) Disinfection of Imhoff Effluent.

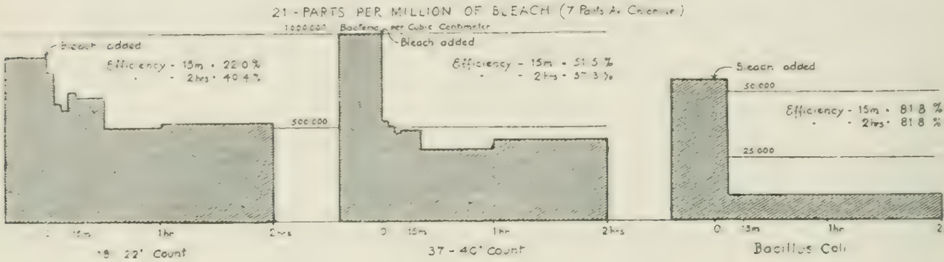
The counts found at different intervals are represented by the dark portion, it will be noticed that high germicidal efficiencies were not attained when using less than 7 parts of available chlorine and that remarkably high efficiencies were attained when using 10 or more parts of available chlorine per million.

DISINFECTION OF SEPTIC EFFLUENT

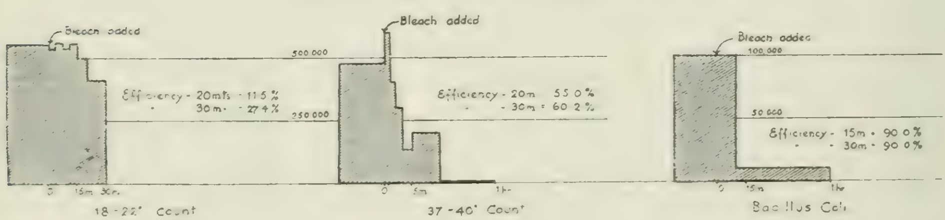
15 - PARTS PER MILLION OF BLEACH (5 Parts Av Chlorine)



21 - PARTS PER MILLION OF BLEACH (7 Parts Av Chlorine)



30 - PARTS PER MILLION OF BLEACH (10 Parts Av Chlorine)



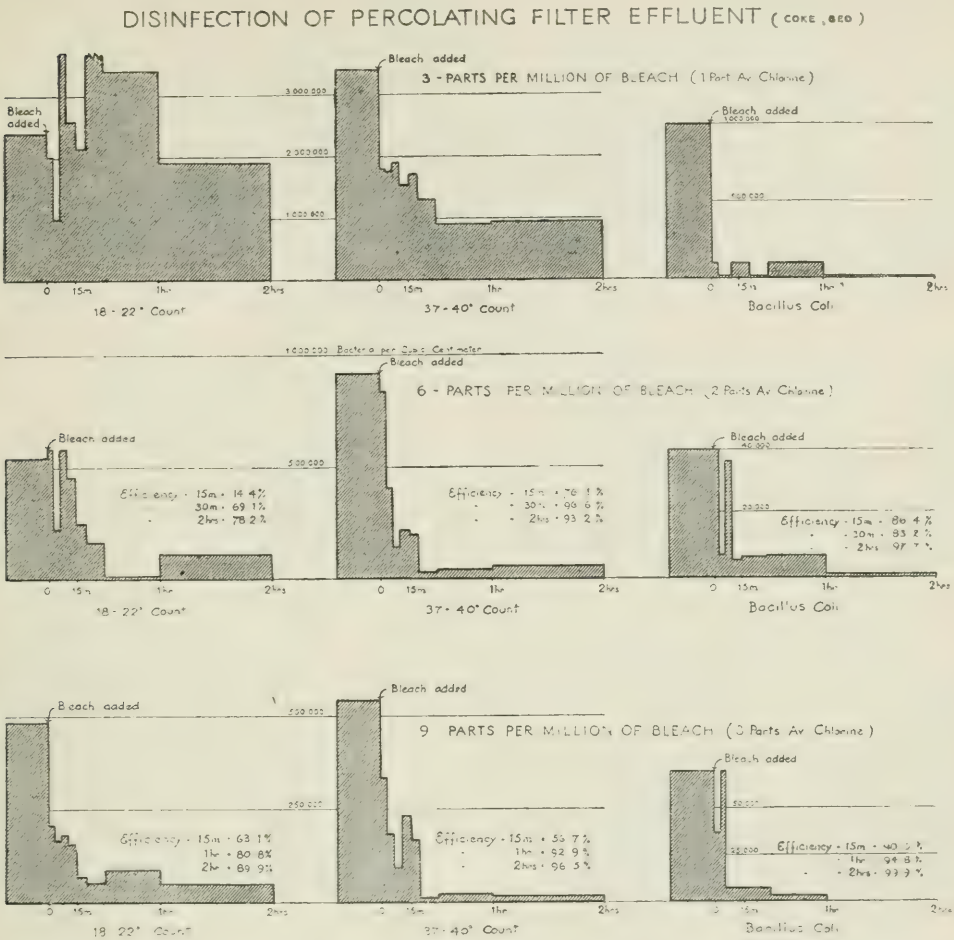
Disinfection of Septic Effluent 15 Parts per Million of Bleach (5 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18 22° C Count	37-40°C Count	Bacillus Coli
Raw	4	557 000	575 000	55 000
3 Min	4	1035 000	860 000	55 000
6 -	4	1070 000	575 000	55 000
10 -	4	952 000	556 000	50 000
15 -	4	835 000	450 000	55 000
20	4	712 000	470 000	10 000
30 -	4	650 000	592 000	10 000
1 Hr	4	500 000	545 000	[illegible]
2 Hrs	4	54[illegible]	405 000	15 000

Disinfection of Septic Effluent 21 Parts per Million of Bleach (7 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18 - 22°C Count	37-40°C Count	Bacillus Coli
Raw	4	885 000	1000 000	—
3 Min	4	800,000	535 000	55 000
6 -	4	645 000	510 000	55 000
10 -	4	602 500	460 000	10 000
15 -	4	690 000	485 000	10 000
20 -	4	677 500	440 000	10 000
30 -	4	670 000	385 000	10 000
1 Hr	4	495 000	375 000	10 000
2 Hrs	4	527 500	427 500	10 000

Disinfection of Septic Effluent 30 Parts per Million of Bleach (10 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18 - 22°C Count	37-40°C Count	Bacillus Coli
Raw	3	565 000	490 000	100,000
3 Min	2	540 000	410 000	100 000
6 -	2	570 000	535 000	100 000
10 -	2	530 000	300 000	100 000
15 -	2	565 000	130 000	10 000
20 -	2	500,000	220 000	10 000
30 -	2	4[illegible]0 000	195 000	10 000
1 Hr	2		52 000	10 000

The samples of Imhoff tank effluent were taken at the effluent pipe leading to the septic tanks. These samples were quite clear, practically all visible suspended particles having been taken out by sedimentation in the tank.

Since the storage period has a very important bearing on the operation of Imhoff tanks experiments were conducted to determine the storage in this experimental tank. Fuchsin was added to the influent and the time required (15 minutes) for the color to appear in the effluent carefully noted. Another experiment to determine the rate of transfusion of Fuchsin was performed in order to apply this correction to the above period of retention. The Imhoff effluent was run into a septic tank at such a rate as to give exactly one hour's retention, Fuchsin was added to this influent and it appeared in the effluent from the septic tank in 40 minutes.



Disinfection of Percolating Filter Effluent 3 Parts per Million of Bleach (1 Part Av Chlorine)				
Interval after adding Bleach	Experiments	18 - 22° C Count	37 - 40° C Count	Bacillus Coli
Raw	2	2 400 000	3 400 000	1 000 000
3 -	2	2 000 000	1 800 000	100 000
6 -	2	1 000 000	1 750 000	10 000
10 -	2	3 700 000	1 900 000	10 000
15 -	2	2 600 000	1 450 000	100 000
20 -	2	2 200 000	1 700 000	100 000
30	2	4 200 000	1 300 000	10 000
1 Hr	2	3 400 000	900 000	100 000
2 Hrs	2	1 900 000	950 000	10 000

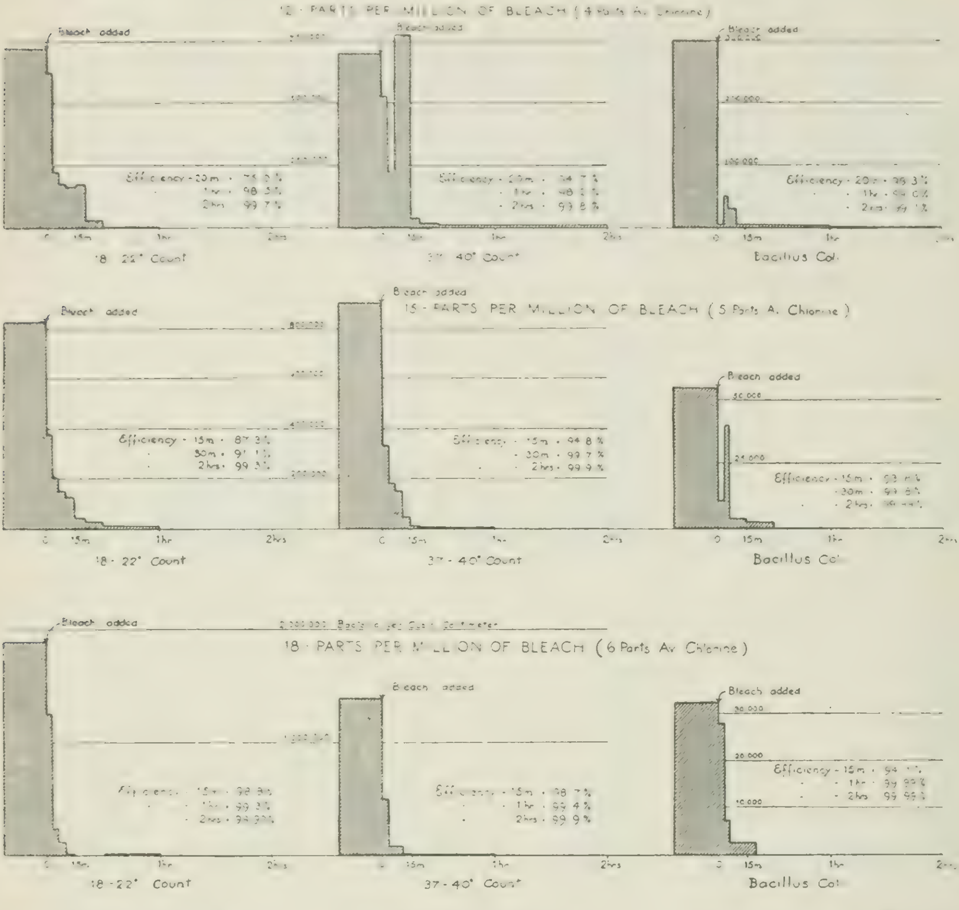
Disinfection of Percolating Filter Effluent 6 Parts per Million of Bleach (2 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18 - 22° C Count	37 - 40° C Count	Bacillus Coli
Raw	6	541 600	911 600	—
3 Min	6	593 000	833 000	40 000
6	6	228 300	488 000	7 000
10 -	6	593 000	145 300	* 34 700
15 -	6	463 000	217 600	5 500
20 -	6	253 000	194 000	6 700
30 -	6	167 000	31 500	6 700
1 Hr	6	14 700	41 800	7 000
2 Hrs	6	112 700	61 800	4 000

Disinfection of Percolating Filter Effluent 9 Parts per Million of Bleach (3 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18 - 22° C Count	37 - 40° C Count	Bacillus Coli
Raw	6	450 000	543 300	70 000
3 Min	6	208 000	343 000	37 000
5	6	170 000	176 000	70 000
10 -	6	203 000	90 000	7 000
15 -	6	156 000	235 000	7 000
20 -	6	73 300	162 600	7 000
30 -	6	51 600	11 300	7 000
1 Hr	6	93 300	39 000	3 700
2 Hrs	6	49 500	20 300	100

* One sample was positive in 0·00001 CC quantity

Evidently the color went through the tank 60÷40 or 1½ times as fast as the Imhoff effluent. Applying this correction to the period taken by the color going through the Imhoff tank, we find the period of detention to be 15 × 1½ or 22½ minutes—when these latter experiments were conducted a revolving spray was being operated with Imhoff effluent in addition to the other percolating filters, etc., and since this spray required as much effluent as all the other filters, etc., put together, then the rate of flow through the Imhoff tank was only half as great at the time the samples were taken and the consequent detention period twice as great, that is 45 minutes.

DISINFECTION OF PERCOLATING FILTER EFFLUENT (COKE BED)



Disinfection of Percolating Filter Effluent 12 Parts per Million of Bleach (4 Parts A. Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	8	720 500	695 000	102 750
3 Min	8	620 000	525 000	[illegible]
6 "	8	[illegible]	227 500	[illegible]
10 "	8	[illegible]	775 000	[illegible]
15	8	[illegible]	772 500	1 275
20	8	160 000	17 000	5 275
30	8	33 250	15 875	3 250
1 Hr	8	11 125	12 375	3 025
2 Hrs	8	2 250	1 300	2 755

Disinfection of Percolating Filter Effluent 15 Parts per Million of Bleach (5 Parts Av. Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	8	[illegible]	845 000	55 000
3 Min	8	397 000	335 000	10 000
6 "	8	191 250	80 000	40 000
10 "	8	[illegible]	[illegible]	4 000
15	9	[illegible]	45 750	3 400
20 "	8	41 250	13 025	2 800
30 "	8	31 425	4 713	70
1 Hr	8	15 000	2 875	70
2 Hrs	8	4 775	513	40

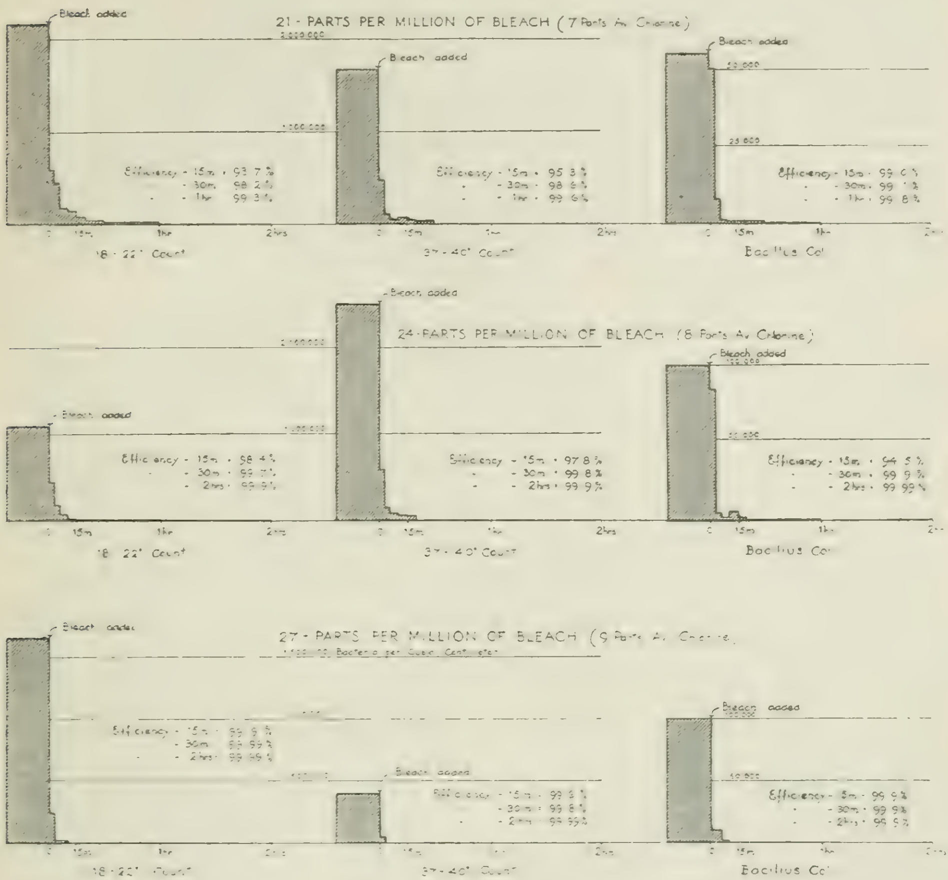
Disinfection of Percolating Filter Effluent 18 Parts per Million of Bleach (6 Parts A. Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	[illegible]	1512 500	1 375 000	32 500
3 Min	8	1 250 000	495 000	28 [illegible]
6 "	8	237 500	77 500	7 350
10 "	8	123 750	92 500	[illegible]
15 "	8	22 615	17 875	5 250
20 "	8	13 500	4 150	3 050
30 "	8	70 500	2 500	67
1 Hr	8	12 875	7 700	4
2 Hrs	[illegible]	80	2 014	10

(c) *Disinfection of Septic Effluent.*

In no case did the treatment of septic tank effluent with bleach produce a high germicidal efficiency. The graphs illustrate the action on this effluent of 5, 7 and 10 parts of available chlorine per million and in no case does a satisfactory disinfection occur. A great many experiments were conducted on the chlorination of this effluent and although it was remarkably clear, it contained very high bacterial counts. The degree of disinfection procured when using even as many as 20 parts of available chlorine per million was rather disappointing.

It seems probable that the exhaustion of the available chlorine of the disinfecting solution is due to the presence of intermediate decomposition products in

DISINFECTION OF PERCOLATING FILTER EFFLUENT (COKE BED)



Disinfection of Percolating Filter Effluent
21 Parts per Million of Bleach (7 Parts Av. Chlorine)

Interval after addn. of Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	4	2 [illegible]75 000	1 000 000	55 000
3 Min.	4	[illegible]	[illegible]	[illegible]
[illegible]	4	429 000	95 000	[illegible]
10	4	[illegible]	36 250	[illegible]
15	4	136 500	[illegible]	[illegible]
20	4	75 000	29 000	[illegible]
30	4	[illegible]	[illegible]	[illegible]
1 hr.	4	[illegible]	[illegible]	[illegible]
2 hrs.	4	[illegible]	[illegible]	[illegible]

Disinfection of Percolating Filter Effluent
24 Parts per Million of Bleach (8 Parts Av. Chlorine)

Interval after addn. of Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	[illegible]	1 049 000	2 481 000	100 000
3 Min.	[illegible]	[illegible]	[illegible]	70 000
[illegible]	[illegible]	158 300	[illegible]	4 000
[illegible]	[illegible]	89 650	[illegible]	[illegible]
[illegible]	[illegible]	23 000	54 000	5 000
[illegible]	[illegible]	[illegible]	46 950	1 000
30	[illegible]	[illegible]	3 300	[illegible]
1 hr.	[illegible]	140	180	40
2 hrs.	6	300	450	10

Disinfection of Percolating Filter Effluent
27 Parts per Million of Bleach (9 Parts Av. Chlorine)

Interval after addn. of Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	2	1650 000	400 000	100 000
3 Min.	2	235 000	40 000	10 000
6	2	15 000	6 500	10 000
10	2	13 000	3 500	1 000
15	2	850	1 550	100
20	2	70	900	100
30	2	10	900	100
1 hr.	2	6	140	100
2 hrs.	2	2	80	100

the septic liquor, the bacterial action in which is mainly anerobic. With regard to these unstable intermediate bodies* Fischer says:—

"The fermentative and putrefactive organisms would seem to have properties not possessed by other organisms, properties which enable them to live in places and under circumstances where a complete combustion of the food-stuffs to CO^2 and H_2O is not possible. The energy that all other plants and animals gain by respiration is obtained by these organisms from a less complete disintegration of the molecules of the respirable substance, the relative smallness of the amount of energy set free being compensated by the large quantity decomposed. In other words, the ordinary respiration of plants and animals is a complete combustion

*The Structure and Functions of Bacteria—Fischer, 1900, pages 135, 136.

of a few molecules, that of the ferment organisms an incomplete combustion of many molecules." Continuing later he says:—"There remain to be said a few words regarding the by-products of fermentation, carbon dioxide, free hydrogen and (in putrefactive processes) ammonia and free nitrogen. Careful investigation shows that there is a whole scale of products, ranging from compounds whose heat of combustion is high, such as alcohol, down to the gases just mentioned, in which it is very low or nil. There seems every reason to believe that the combustion of both the chief and the by-products is gradual, by stages. In this way there must be going on a number of different processes simultaneously in the cell, the various compounds being decomposed, and their energy tapped step by step, a process which must necessarily result in the formation of a large number of bodies of different composition—by-products."

Thus we see that besides producing ammonia and free hydrogen, which have a great affinity for chlorine, a great many organic by-products are formed. It seems probable that the length of the septic interval is of considerable importance since this interval determines largely the quantities of ammonia, free hydrogen and organic by-products produced.

	Nitrogen as Free Ammonia.	Nitrogen as Albuminoid Ammon.	Oxygen Consumed in 5 Minutes.
Imhoff Effluent	19.11	11.3	64.0
Septic, effluent 16 hours' storage	28.7	5.24	36.75

The septic tanks were so arranged as to admit Imhoff effluent at a definite rate, permitting 16 hours' storage. The capacity of each tank was 228 cubic feet and the depth of sewage was 6 feet. The effluent from these tanks was particularly clear and transparent.

(d) Disinfection of Percolating Filter Effluent (Coke Bed).

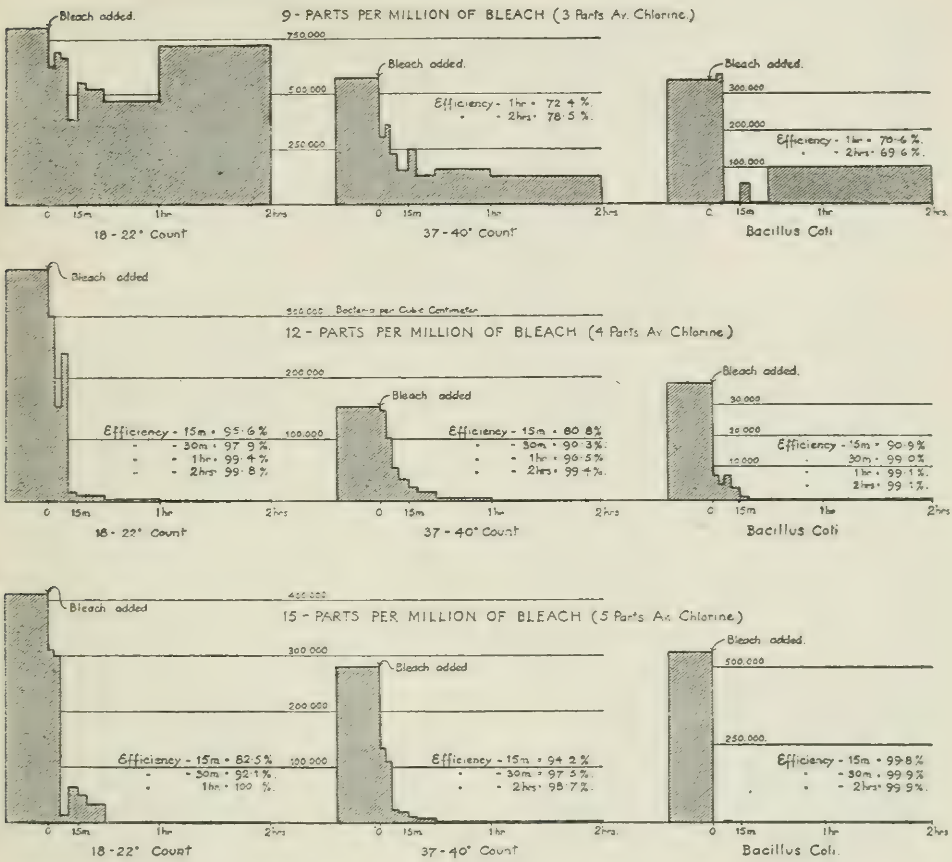
The treatment of this effluent with chloride of lime or bleach was productive of particularly good results. High germicidal efficiencies were procured after 1 hour's storage when as little as 4 parts of available chlorine per million was added. (See graph page 202.) Six parts of available chlorine per million produced high germicidal efficiencies after a storage of only 15 minutes, after 2 hours' storage an average efficiency of 99.96 per cent. was procured, almost sterilization. Very high efficiencies are shown when using 7 and more parts per million of available chlorine and particular attention might well be drawn to the case wherein 9 parts are used, an average efficiency of 99.8 per cent. being procured after only 15 minutes' storage.

It must be remembered that these efficiencies are figured on a basis of the number of bacteria in the effluent before treatment with chloride of lime and not on a basis of the number of bacteria in the raw sewage. If calculated from the latter case the efficiencies would be very much greater since the Imhoff tank and percolating filter alone are responsible for a reduction of the number of bacteria by over 60 per cent.

The experimental coke percolating filter was $\frac{1}{500}$ acre in area, the depth of media being 5 feet. Imhoff effluent was sprinkled on to this bed, by means of two sprays, at a rate of 1,280,000 gallons per acre per day. During the fall and early winter the effluent from this tank was very clear; towards spring the presence of small particles of humus in suspension in the effluent became evident. At this time there was present a thick algae growth on the surface of the filter. The cold weather seemed to materially encourage the growth of this algae.

In the early spring when the algae growth was particularly heavy, the filter surface was vigorously washed with clean water by means of a hose and the entire

DISINFECTION OF PERCOLATING FILTER EFFLUENT (BROKEN GLASS).



Disinfection of Percolating Filter Effluent. 9 Parts per Million of Bleach (3 Parts Av. Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	6	806 500	570 000	340 000
3 Min	6	630 000	300 000	340 000
6 "	6	697 000	351 600	370 000
10 "	6	657 000	[illegible]	7 000
15 "	6	383 300	151 600	6 700
20 "	6	562 500	247 500	55 000
30 "	2	530 000	132 500	5 500
1 Hr	2	480 000	137 500	100 000
2 Hrs	2	725 000	122 500	102 300

Disinfection of Percolating Filter Effluent 12 Parts per Million of Bleach (4 Parts Av. Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	6	376 700	151 600	37 000
3 Min	6	302 500	145 700	7 000
6 "	6	153 300	103 300	4 000
10 "	6	241 600	53 830	7 000
15 "	6	16 706	30 300	3 700
20 "	6	10 000	22 160	1 000
30 "	4	8 000	14 670	370
1 Hr	4	2 500	5 250	340
2 Hrs	4	1 000	1 000	340

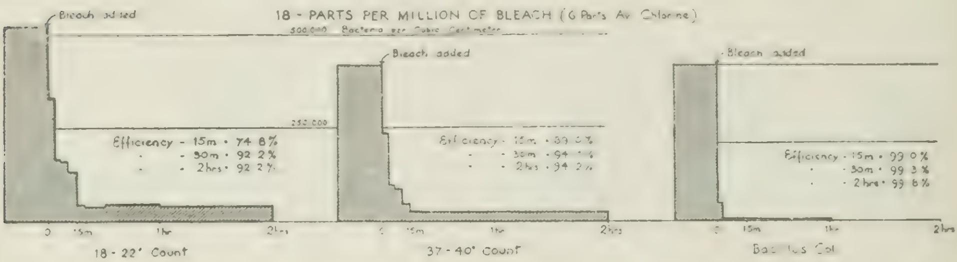
Disinfection of Percolating Filter Effluent 15 Parts per Million of Bleach (5 Parts Av. Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	4	410 000	315 000	550 000
3 Min	4	345 000	142 500	1 000
6 "	4	223 000	122 500	55 000
10 "	4	14 770	2 350	1 000
15 "	4	71 500	18 250	1 000
20 "	4	49 500	11 750	5 050
30 "	4	32 150	7 875	505
1 Hr	4	0	3 150	505
2 Hrs	4	0	4 000	505

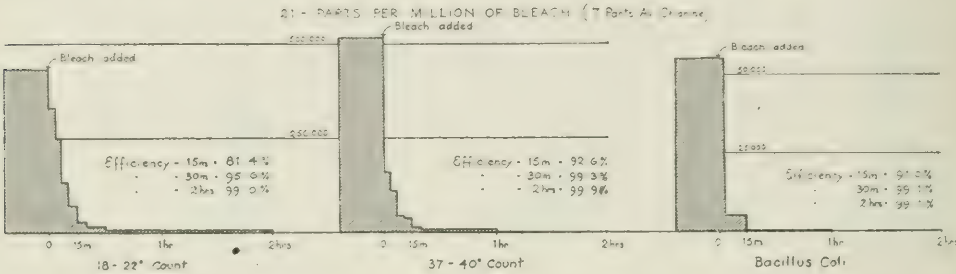
filter media inundated for a period of 24 hours. The water, which was then allowed to drain off, carried with it a great deal of humus. The filter was again put into operation and no further trouble encountered.

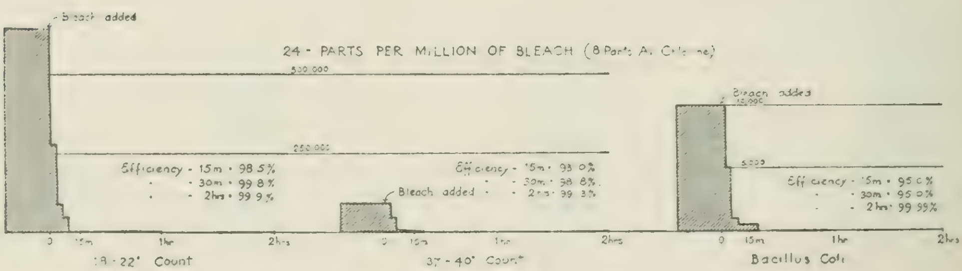
(*e*) *Disinfection of Percolating Filter Effluent* (*Broken Glass*).

The effluents from the broken glass and coke percolating filters showed very similar results on chlorination and to a great extent, what applies to one applies equally well to the other. A high efficiency was procured when using as low as 4 parts of available chlorine per million, provided a storage of at least 30 minutes be given. The addition of 5 and 6 parts of available chlorine per million does not give a high efficiency under 30 minutes' storage as will be seen from the graphs.

DISINFECTION OF PERCOLATING FILTER EFFLUENT (BROKEN GLASS)







Disinfection of Percolating Filter Effluent
18 Parts per Million of Bleach (6 Parts Av Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	6	526 700	413 750	550 000
3 Min	6	340 300	231 600	55 000
6 "	6	173 300	94 160	5 050
10 "	6	161 330	84 160	5 050
15 "	6	132 500	45 330	5 500
20 "	6	45 800	26 100	5 500
30 "	6	40 800	24 100	3 670
1 Hr	6	48 080	26 800	5 005
2 Hrs	6	40 670	23 400	370

Disinfection of Percolating Filter Effluent
21 Parts per Million of Bleach (7 Parts Av Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli.
Raw	4	440 000	512 500	—
3 Min	4	335 000	150 000	55 000
6 "	4	260 000	110 000	5 500
10 "	4	132 500	43 000	5 500
15 "	4	81 500	38 000	5 050
20 "	4	28 000	12 500	550
30 "	4	19 250	8 400	55
1 Hr	4	5 700	3 500	500 5
2 Hrs	4	4 550	1 000	500 5

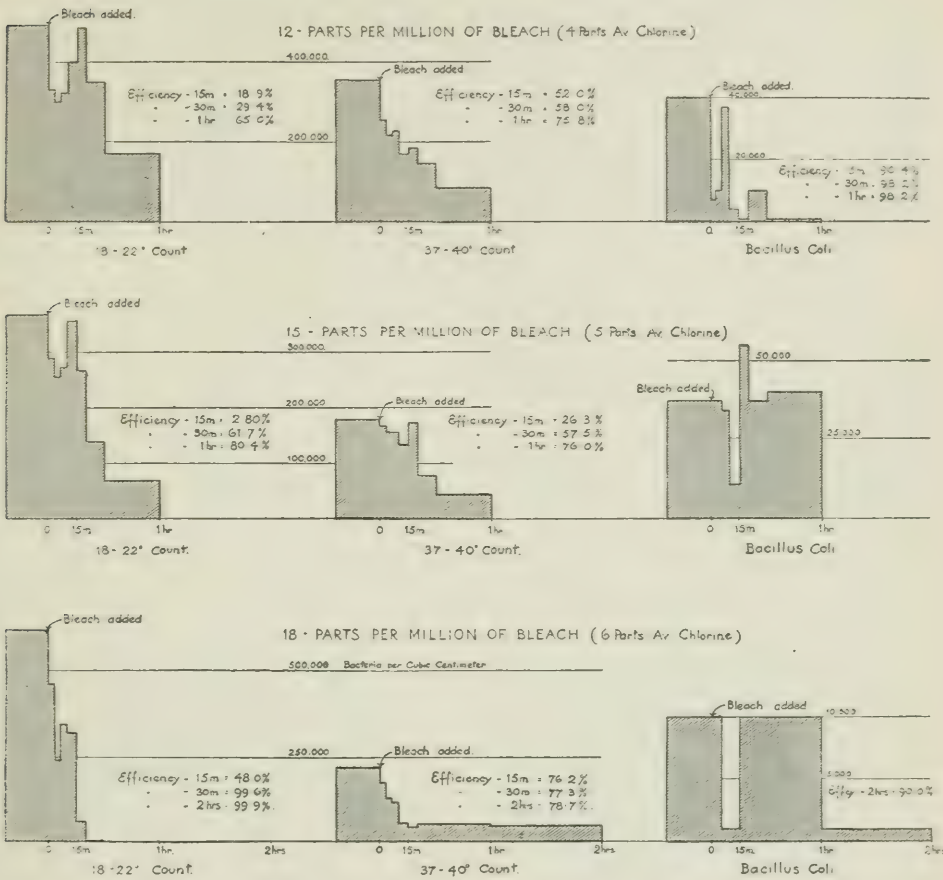
Disinfection of Percolating Filter Effluent
24 Parts per Million of Bleach (8 Parts Av Chlorine)

Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	4	550 000	90 000	10 000
3 Min	4	287 500	92 500	10 000
6 "	4	92 500	47 500	5 050
10 "	4	47 500	11 750	1 000
15 "	4	10 000	6 250	505
20 "	4	5 350	2 800	500 5
30 "	4	1 350	1 675	510
1 Hr	4	750	1 200	0 6
2 Hrs	4	295	600	0 6

When using 8 parts of available chlorine a very fair efficiency was procured after a storage of only 15 minutes. In practice the addition of 7 or 8 parts of available chlorine would no doubt give this effluent a high degree of disinfection and should be a very satisfactory treatment.

The area of the experimental broken glass percolating filter was $\frac{1}{500}$ acre and it received Imhoff effluent by means of a spray at a rate of 785,000 gallons per acre per day. The surface of this filter became covered with a thick mat of algae growths towards the middle of the winter, creating an undesirable condition very inducive to anerobic action within the bed. The cleaning of this filter was easily accomplished by washing the surface with the hose and flooding the bed. The masses of algae and particles of humus were detached very easily from the surface of the glass and washed out of the filter.

DISINFECTION OF PERCOLATING FILTER EFFLUENT (BROKEN STONE)



Disinfection of Percolating Filter Effluent. 12 Parts per Million of Bleach (4 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count.	37-40°C Count	Bacillus Coli
Raw.	6	492,000	353,000	40 000.
3 Min	6	333 000	253 300	7.000
6 -	6	301 600	218 300	10.000
10 -	6	323 300	226 600	37 000
15 -	6	400,000	170.000	3700
20 -	5	483 300	186 600	700
30 -	6	348 300	148 300	10 000
1 Hr	6	172.500	85 160	700

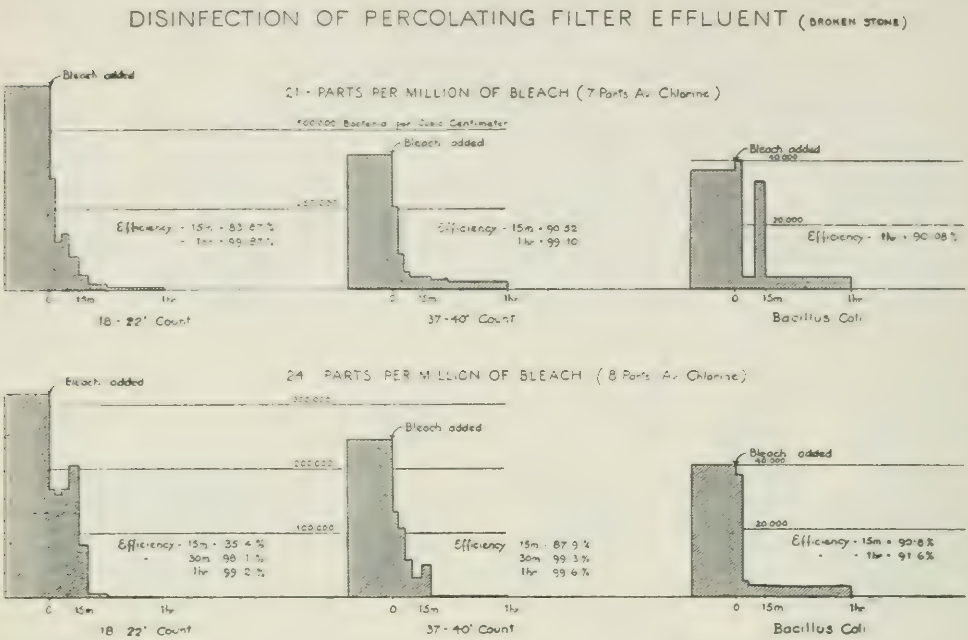
Disinfection of Percolating Filter Effluent. 15 Parts per Million of Bleach (5 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count	37-40°C Count	Bacillus Coli
Raw	6	363 300	181 600	—
3 -	6	258 300	168 300	—
6 -	6	260 000	156 600	37 000
10 -	6	273 000	157 300	34 000
15 -	6	353 000	135 000	10.000
20 -	6	269 000	173 000	55 000
30 -	6	139 300	77 000	37 000
1 Hr	6	71 000	43 600	40.000

Disinfection of Percolating Filter Effluent 18 Parts per Million of Bleach (6 Parts Av Chlorine)				
Interval after adding Bleach	Experiments	18-22°C Count.	37-40°C Count	Bacillus Coli
Raw	4	615.000	215 000	10 000
3 Min	4	462 500	170 000	10 000
6 -	4	237 500	124 000	10 000
10 -	4	340 000	114,000	1000
15 -	4	318 500	51 200.	1 000
20 -	4	59 000	40 250	10 000
30 -	4	2250	48 750	10 000
1 Hr	4	425	47 900	1 000
2 Hrs	4	200	45 800	1.000

(*f*) *Disinfection of Percolating Filter Effluent* (*Broken Stone*).

Previous to these experiments the broken stone percolating filter was seriously neglected, sewage was sprayed upon the bed at a high rate, with the result that the entire filter became badly clogged and the surface covered with dense algae growths, septic conditions were also induced within the bed. These conditions are probably responsible for the fact that the efficiency of the chloride of lime disinfection was lower than for the other percolating filter effluents.

The average efficiencies procured when using 4, 5 and 6 parts of available chlorine per million were not high even after two hours' storage. A high efficiency with regard to count was produced by 7 parts of available chlorine when allowed



Disinfection of Percolating Filter Effluent 21 Parts per Million of Bleach (7 Parts Av. Chlorine)				
Interval after adding Bleach	Experiments	18 - 22° C Count	37 - 40° C Count	Bacillus Coli
Raw	6	645 000	408 000	37 000
3 Min	6	350 000	256 000	40 000
6	6	148 300	109 300	3 700
10	6	175 500	52 300	3 370
15	6	104 000	[illegible]	22 670
20	6	[illegible]	37 000	3 470
30	6	15 870	31 500	[illegible]
1 hr	6	[illegible]	24 800	[illegible]

Disinfection of Percolating Filter Effluent 24 Parts per Million of Bleach (8 Parts Av. Chlorine)				
Interval after adding Bleach	Experiments	18 22° C Count	37 - 40° C Count	Bacillus Coli
Raw	[illegible]	318 300	245 000	40 000
3 Min	[illegible]	155 300	134 160	37 000
6	6	131 250	108 000	4 000
10	6	170 000	58 600	3 670
15	4	206 000	30 500	3 670
20	4	83 000	50 100	3 370
30	4	6 080	1 650	3 370
1 hr	2	2 500	550	3 337

1 hour's storage and by 8 parts of available chlorine when allowed 30 minutes' storage, but in neither case was the reduction in bacillus coli very satisfactory.

It is clearly evident that if percolating filters are allowed to become clogged with humus or covered with algae growths, the effluent will require at least as much disinfecting agent as raw sewage.

The area of this bed was $\frac{1}{500}$ acre, and like the previous percolating filters it received Imhoff effluent by means of a spray, the rate in this case being 665,000 gallons per acre per day during these experiments.

5. Significance of Certain Information in Charts and Conclusion.

By closely examining the graphs one can derive a good idea of the action of the chloride of lime on a sewage containing from three to five millions of bacteria per cubic centimeter. The graphs showing its action on raw sewage illustrate very nicely the benefits derived by the addition of different quantities. Compare the graphs on page 191, showing the action of one, two and three parts of available chlorine per million with those on page 192, showing the action of four, five and six parts of available chlorine: while the results on page 191 show high efficiencies on occasions, yet a great many inconsistencies occur and it is plainly evident that

good results would only be attained intermittently. The results on the second sheet show a much greater and uniform reduction although some inconsistencies in the graphs are still evident. Six parts of available chlorine per million gives a good efficiency after two hours and the efficiency at the end of one hour is fairly high. From the use of seven parts and upwards high efficiencies are shown after a fifteen-minute period of detention.

It is obvious that raw sewage containing from three to five millions of bacteria per cubic centimeter should be treated with not less than seven and preferably eight parts of available chlorine per million and given a detention after treatment of not less than twenty minutes.

On carefully looking over the graphs of the work on Imhoff effluent it will be seen that the above conclusions apply equally well to this effluent. The remarkably high efficiencies attained when using ten and more parts of available chlorine are worthy of note.

The septic tanks were arranged so as to give 16 hours' detention to Imhoff effluent and in no case did the chlorination of septic effluent give a satisfactory result even when as much as 21 parts of available chlorine per million was added. An explanation of this phenomena has been given elsewhere and so does not need to be repeated here. In view of these observations septic tank treatment does not commend itself in conjunction with chlorination as a means of treating the sewage of municipalities.

The question is frequently asked, at what point in the treatment process is it most advantageous to add the chloride of lime. A great many plants have been built with the chlorination station situated on the final effluent pipe, so that the chlorinated effluent runs directly into a lake or stream with no retention whatever, other plants have been built with the chlorination station situated at other places equally unfit. Cases such as these are worse than wasteful since they lead people to believe that their sewage is being properly disinfected when as a matter of fact the actual disinfection may be practically negligible. It was with the idea of throwing some light on such common and practical considerations as these that this investigation was conducted and as a result the writer believes that up to the present time sufficient attention has not been given to this phase of sewage disposal. It was also felt that a great many investigations have been published, leaving the drawing of conclusions and inferences too much to the reader. This report has been prepared with the desire to make such recommendations and suggestions to the reader, as would cause him to go back over the report and weigh out for himself the significance of the observations.

In general it may be said that in order to obtain high efficiencies when disinfecting by means of chlorination two important conditions must be met. First, the sewage must be kept fresh, since putrefaction interferes very seriously with germicidal action of chloride of lime, and second, it is imperative that a retention period of at least twenty minutes be provided for after the addition of the disinfectant.

Appendix

Media.

At the Experimental Station since large quantities of nutrient agar and bile media were used, it was found necessary to make up all medias in large quantities sufficient for several days' requirements. Fresh minced veal was bought in lots of thirty pounds and set soaking in the late afternoon or evening and left until the following evening when it was put to drain over night in a cheese-cloth bag.

The following morning the media was made up according to the standard methods of the American Public Health Association. Using this technique it was found that the veal was drained out as dry as could have been by the laborious hand method. Of course in using this technique it was necessary to procure nothing but fresh veal.

Double strength bile media was also made up in large quantities, twenty litres on the average being made up at one time. It was placed in Winchesters, sterilized and kept for use as required.

For one and five centimeter tubes one part of this bile media was mixed with two parts of water (two-thirds strength); for twenty-five centimeter tubes one part was mixed with one part of water (single strength), and for fifty centimeter tubes full double strength media was used. All pouring was done by placing baskets of tubes on a tray and siphoning the liquid through rubber tubing, filling all tubes to a predetermined height. Throughout the entire work methods allowing a saving in time and labour were studied and used, provided they did not interfere in the slightest with the spirit of the standard technique.

Agar, like bile media, was siphoned through rubber tubing into the tubes; care had to be taken to see that it was completely melted and quite hot in order that it would remain viscous until the pouring was completed. Enough agar was siphoned into each tube to pour two plates (about 20 cc.) so that only half the plugging and otherwise handling was required as would have been necessary if only sufficient had been put in each tube to pour one plate.

(*a*) *The Pouring and Sterilizing of Dilution Bottles.*

The technique used in plating sewage samples involved the use of large numbers of dilution bottles, these were poured and sterilized in lots of about 220. The bottles were placed in about five rows of some forty each, alongside the outer row was placed a wooden standard, the top of which was at the height reached in the bottles by 100 cubic centimeters of water. As each row was poured it was slid along the table and the standard placed against the next row, and so on until all were poured. The water was siphoned through rubber tubing from a container placed about two feet above the bottles. By using this method it was found that one man could pour and place in the autoclave 220 bottles in 45 minutes. In order to insure perfect sterilization the autoclave was kept at fifteen pounds pressure for 30 minutes. The corks were placed in baskets and put into the autoclave along with the bottles; after the autoclave was opened and the glassware frequently still hot they were placed in the bottles by means of a pair of sterilized tongs.

Dilutions of the sample of sewage were obtained by pipetting 1 or 10 cc. of the sample into a dilution bottle containing 100 cc. with the added quantity. This gave a dilution of 1 in 100 or 1 in 10 as required, greater dilutions were made by following the same procedure and taking 1 cc. from the first dilution bottle and placing in a second and so on. A regular technique of 50 shakes was employed for both samples and dilutions through the entire work.

(*b*) *Washing and Sterilizing Petri Dishes.*

In all about 200 Petri dishes were used each day at the Experimental Station, and it is readily seen that washing and sterilizing them involved a considerable amount of time and labour. However, a technique was finally hit upon by which 200 plates could be washed and placed in copper boxes ready for sterilizing in 30 minutes. The dirty plates were placed on the right-hand side of the sink while

Media and Fermentation Tubes used to locate the presence of B. Coli communus in water. Experimental Station, 1913.

A convenient table arrangement for plating large numbers of samples. Experimental Station, 1913.

the empty boxes were placed on the left. The hot water tap was adjusted so as to send out a jet of water with some little force; then taking a Petri dish cover in one hand and the bottom in the other they were thrust under the jet. The agar was found to be taken off completely in but a second or so and the dishes were put together and placed in an empty box. As each box was filled the cover was closed and it was placed on its side to drain. (Note, this method is only recommended where clean hot water is available for each dish.) By the time all the plates were washed the first boxes were sufficiently drained to start putting into the hot air sterilizer. All plates, pipettes and bottles were sterilized at a temperature of at least 200° C. for one hour. After filling the sterilizer the flame was turned on low for about 15 minutes, it was then turned on full and usually required about 45 minutes to raise the contents to 200° C. The timing was started at this point; the final temperature was frequently as high as 260° C.

The Petri dishes and Fermentation tubes were identified by marking placed thereon by means of a blue grease pencil.

(c) *Washing of Agar and Culture Tubes.*

Agar tubes were washed in basket lots, by filling them with very hot water and running a brush into each, they were then rinsed out with hot water and turned upside down to drain.

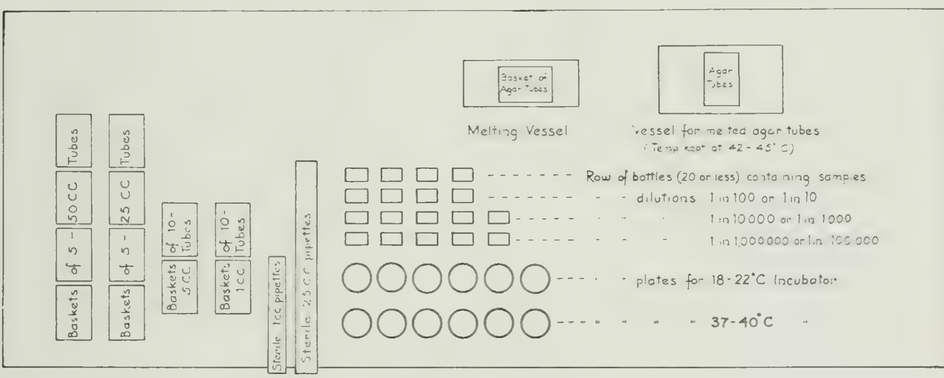


TABLE ARRANGEMENT.

It was also found quick and convenient to wash U-tubes without taking them out of the baskets, this was done by simply holding a basket of them under the tap until the plugs were thoroughly soaked, upon which they could be pulled out very easily, leaving no cotton adhering to the sides of the tube. After taking out the plugs the bile was poured out and the tubes rinsed out twice with hot water.

The plugs of 25 and 50 cc. tubes were pulled out while dry, the contents of each basket of tubes was then dumped into the sink; the tubes were then filled with hot water, swabbed out, rinsed and put away. The inner tubes were rinsed out, placed in baskets and put away; they were inserted after the media was poured and before sterilization.

(d) *The Chlorination of Samples.*

The volume of the glass container used for sampling was about 175 cc., however only 150 cc. of the sample was put into each container, so the exact amount of

chlorine solution required to give any number of parts per million could be easily placed in baskets and put away; they were inserted after the media was poured and before sterilization.

The standard chlorine solution used was of such strength that one cubic centimeter in 99 cc. of a sample gave one part (of available chlorine) per million. This solution was made up every day or so and checked daily by the chemist at the Experimental plant, so that the exact amount necessary to add to each sample in order to give any required quantity of available chlorine was known each day. If, for example, the chlorine solution was of standard strength and we wished to add 4 parts of available chlorine to a sample, then by means of a pipette $4 \times \frac{150}{100}$ or 6 cc. of the sample was taken out and 6 cc. of the standard solution added.

The strength of the standard chlorine solution was found by titration with sodium thiosulphate solution. It was found that the strength of the standard solution deteriorated about 10 per cent. per day if kept in the light in a clear transparent glass bottle, while the deterioration was less than one per cent. if it was kept in a very dark blue bottle not directly in the light.

The work and technique* involved during the complete examination of a single sample of sewage was as follows:—

The sample was given 50 vigorous shakes, then 1 cc. was taken out and put into a dilution of 0.01 cc. and similarly by diluting 1 cc. from this bottle and so on, dilutions of 0.0001 cc. and 0.000001 cc. were made. Then 1 cc. taken from the third dilution bottle and put into a U-tube gave a dilution of 0.000001 cc.; 0.1 or 2 drops taken from the second dilution bottle and put in a U-tube gave a dilution of 0.00001 cc. and 1 cc. taken from the second bottle gave a dilution of 0.0001 cc. From the same bottle 1 cc. was put into each of 4 Petri dishes and then agar was poured into them. Two plates were used for the 18-22° C. count and two for the 37-40° C.

After plating samples from the raw sewage the chlorine solution was added and at different intervals samples plated in the same way, excepting that the longer the interval the smaller the dilutions required on account of the germicidal action of the chlorine. This, of course, was not so pronounced when the sample was treated with small quantities of available chlorine.

In tubing sewage samples the 50 and 25 cc. tubes are seldom necessary, unless the disinfection is being carried on to such an extent that they are required to show the absence of colon in such quantities. For all dilutions 1 cc. U-tubes were used.

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* See photograph opposite page 211 for table arrangement.

DISINFECTION WITH CHLORIDE OF LIME.

Experimental Plant

Page No 40

Date	Sample		Bacterial Counts — Incub Temp 18-22° C Plain Agar, 48 hours Incubation: 0.0001 cc	0.001 cc	0.01 cc	0.1 cc	Bacterial Counts — Incub Temp 37° C Plain Agar 24 hours Incubation: 0.1 cc	0.01 cc	0.001 cc	0.0001 cc	Colon Bacilli Fermentation Test 48 hours Incubation 37° C: *0.0^51 cc	0.0^41 cc	0.0^31 cc	0.0^21 cc	0.01 cc	0.1 cc	1 cc	5 cc	10 cc	25 cc	50 cc	Remarks	Time Interval after adding Chlorine.
Dec 24 · 1913	SEWAGE FROM PUMP	Raw	95							140	+	+	+									Agar	
			65							98												8·5 Acid	
		8 pts Av	78							45	0	0	+										2 Min
		Cl added	46							35													
			60							34		0	+	+									4 "
			70							30													
				110					85			0	+	+									7 "
				160					73														
				50					60			0	0	+									10 "
				140					85														
				100					72			0	+	+									15 "
				94					38														
					300			240					0	+	+								20 "
					250			210															
					120			150					0	0	+								30 "
					220			140															
					12			80						0	0	0	+						1 Hr
					22			20															
						150	360								0	0	0	+					2 Hrs
						140	230																
		* Note	$- 0.0^51 =$	0.000001																			

Table showing method of tabulating results. Experiment dated Dec. 24th, 1913.

APPENDIX A

APPENDIX "A."

The reports appearing in this Appendix were received from the Secretaries of the different Local Boards of Health of the cities and towns of the Province, in conformity with section 23, ss. 3, of the Public Health Act, and have been edited by the Secretary of the Board.

BERLIN.

Dr. John McGillawee, M.O.H.

I beg to present the report of the Medical Officer of Health for the year ending November 26th, 1913. For various reasons the meetings of the Board of Health have been numerous in the past year. There have been twenty-six meetings and the members are to be highly commended for their regular attendance and for the lively interest they have taken in Board of Health work.

There were three hundred and six deaths registered with the City Clerk during the year. As is inevitable in a city of the size of Berlin, there have been a number of cases of infectious diseases. There were thirty-six cases of diphtheria, with six deaths. All of the deaths followed the croupous form of diphtheria. In most of the cases of death the serious nature of the illness was not recognized at the outset and no physician was called until it was too late to save the life of the patient. Fourteen cases were treated at the Isolation Hospital. I consider the hospital has done much to prevent the spread of the disease. In no instance has there been a second case developed in a family from which the patient has been removed to the hospital. The free use of antitoxin, liberally supplied by the Board of Health, has no doubt saved many lives and also acted as a preventive to the spread of the disease.

The city has been fortunate in having had no serious outbreak of scarlet fever during the last two years. During the past year there were only five cases of scarlet fever, with no deaths.

We have had a number of cases of measles, with no deaths. Measles has properly been placed on the list of infectious diseases which must be placarded.

Four deaths were attributed to complications following whooping cough.

There have also been a number of cases of German measles and chicken-pox. Both diseases have been light.

Typhoid fever has been comparatively light. With the exceptions of in one or two cases the disease was shown to have been contracted outside of the city. Two deaths from typhoid fever.

There were twelve deaths from tubercular diseases.

There were twelve cases of smallpox during the year. By strict quarantine and thorough disinfection, and by the vaccination of all persons exposed, the disease was confined to a few families. Six cases were treated in the Smallpox Hospital.

The milk supply has been good. There has been an improvement in the quality of the milk and in its cleanliness. The enforcement of the regulation requiring all milk to be delivered in bottles has also been an improvement.

The city water has been pronounced pure by the Provincial Laboratory. The new reservoir, with its capacity of one million gallons, should ensure a supply of pure water for the future.

I wish to mention the efficient work done by Sanitary Inspector Buchhaupt during the year and also to call your attention to the fact that owing to the rapid growth of the city and to the extra number of diseases which the Provincial Board requires to be placarded, with the premises to be disinfected afterwards, the work of the Sanitary Inspector has increased to such an extent that it is imperative that he be provided with a horse for his constant use.

The need of a city abattoir, with proper meat inspection, is being realized by all citizens, and I trust it is only a question of a short time until Berlin is fully equipped in that respect.

Chas. A. Ahrens, Chairman.

As Chairman of the Board of Health, I beg to report as follows regarding the work of the Board for the past eleven months:

We have held eleven regular and seventeen special meetings. The large number of extra meetings were due mostly to the outbreak of smallpox in the beginning of the year, and the abattoir question.

We have been very fortunate in preventing contagious diseases from spreading, which no doubt is due to having the isolation hospitals to take care of the patients. These houses are of more value to our city, I think, than the general public are aware of. Before we had them it was very annoying, also expensive, to guard houses wherein cases of contagious diseases existed, as in some cases they had to be guarded day and night. After the caretaker's residence is completed we will have a very good outfit.

As to the public abattoir, your Board has tried very hard to have one established, but so far has not met with very much success. However, if it is not possible to go the whole way towards such an institution and have inspected meat, our City Council for 1914 should see to it that they make some move towards that end; they should at least build a slaughter-house. Our city butchers are ready for something. They are continually being hounded about not complying with the law. They are aware of it and are ready for most anything to stop the annoyance. If nothing is done they will put up their own slaughter-houses somewhere, and I want to impress it on your honorable body that one of the most disagreeable things that the Board of Health has to do is to look after all the different slaughter-houses scattered in all directions. This in the past has certainly been a disagreeable and disgusting job. If all could slaughter in one place it could be kept sanitary and up to a standard.

The milk supplied to the city is being kept up to the required standard. It is now being delivered in bottles, which is a more sanitary way of handling it and should not increase the price. The statement made by one of our vendors to the contrary is emphatically denied by our Board, as some have delivered in bottles for years without increasing the price.

Overcrowding in dwelling houses has been looked after as well as possible. Scarcity of houses naturally encourages overcrowding. Several houses were found in a very unsanitary condition, and one was condemned and closed up until put into sanitary condition.

Our Medical Officer of Health deserves great credit for his work in the past year. Nothing seemed too much for him to do to keep contagious diseases from spreading. He is a very conscientious worker. As soon as a case would be reported, he was after it and stayed with it day and night when it was necessary.

For our Sanitary Inspector I can say the same. His duties have reached such a stage that he should be supplied with a horse for his own use. It is impossible for him to get around to the different parts of the city where his duties call him and do justice to his office or himself. Also I think his duties should be lightened, as he is really overworked at times.

BRANTFORD.

Dr. F. G. E. Pearson, M.O.H.

I beg to present a brief report of the Health Department of the city of Brantford for the year ending October 31st, 1913.

Mortuary Statistics.—During the past twelve months there have been recorded, exclusive of still-births, 370 deaths, which in a population as obtained from the assessors' returns of 26,454, gives a mortality rate of 13.9 per thousand.

The above I may add includes a number of deaths which occurred in the hospital, which were from outside the municipality, and should not be chargeable to it, and will thus explain some apparent difference that will occur in another part of this report, where matters deal with occurrences alone of the city.

As to causes it was noted:

10 were due to pneumonia.
19 were due to tuberculosis.
6 were due to typhoid fever, 2 being outside cases.
7 were due to diphtheria, 2 being outside cases.
46 were due to cholera infantum and infantile intestinal troubles.
6 were due to meningitis.

As to age:

109 were under 1 year.	73 were over 60 years.
25 were under 5 years.	36 were over 80 years.

In this matter it is particularly of note the large number of deaths that occur under one year and also out of this group that no less than 46 were due to cholera infantum and infantile digestive diseases, and particularly during the summer months was this in evidence; it brings up again the subject of food and feeding, for no doubt if the proper conditions with regard to these matters were observed a great many of these cases could have been saved. This is an important matter and one which deserves earnest attention and again convinces me that a municipal depot, where properly sterilized milk could be obtained, under the care of a special nurse who could instruct mothers, etc., would have a decided effect in reducing this mortality.

Contagious Diseases.—During the past twelve months there have been recorded in all 127 cases of contagion, with 9 deaths, and as compared with last year, which was the lowest on record, viz., 115 cases, with 8 deaths, is a very creditable showing, our excess being made up by typhoid as dealt with in a future part of this report, and were as follows:

Diptheria.—Of this disease for the period of this report there were 24 cases, with 5 deaths.

Scarlet Fever.—Of scarlet fever we had in all 57 cases, with no deaths.

Typhoid Fever.—For the twelve months there were 37 cases of typhoid, with 4 deaths, as compared with 25 cases and 7 deaths the year previous, and in connection with these cases it is worthy of note, with the exception of 6 or 7, the remainder were due to outside sources of infection, either having returned from holidays and visits in other parts, or as in one particular group which occurred among persons who had attended an excursion to Niagara Falls, out of which no less than 19 developed the disease within a couple of weeks, since when our typhoid practically ceased.

Smallpox.—During the year we have had two cases of smallpox, both of which were contracted from outside sources. In connection with this trouble I wish again to call the attention of the Board to the very inadequate means we have for caring for this disease, and as such cases will occur from time to time, in previous reports I have shown that the present structure is totally unfit for caring for this or any other disease. It is, therefore, urgent that some immediate steps be taken to provide a suitably located and adequately equipped building in which patients can be given proper care. To this matter I know the Board has given their attention and have looked into certain premises which I think could be made suitable, and therefore I feel that no further time should be lost in again urging upon the Council the necessity of action in this direction.

Milk and Dairy.—Following upon the report of the Ontario Milk Commission, certain progressive legislation has been enacted, among others the placing of the power of inspection in the hands of the consumers. It has also been provided that municipalities may pass by-laws regulating the standard of the product to be supplied. In connection with the former, this Board appointed Dr. Cutcliffe as Veterinary Inspector, and from his report, which is before you, you will see that good work has been done, as the object of such inspection is not only to see the herds, premises, etc., but in a large degree educative, for although the great majority of dairies are fairly well located and equipped, the many small details that go to make up a good supply are frequently neglected and the inspector's duty is to note these and explain the necessity of them being followed out, all of which can be accomplished with very little expense and carefulness.

For the most part we have had the co-operation of the producer.

Although in some instances there has been some apparent objection, there are cases in which an inspection is required, in fairness to those who are doing their best, and to the consumers, dealers should either maintain their premises properly or else cease to be in business, and from the facts gleaned, I propose to have this Board recommend the adoption of by-laws and regulations by the municipality fixing standards, etc., and that reports in the future will be upon the card system, which, dealing with the specific conditions, will automatically advertise those who are making efforts to live up to the requirements that will insure the best quality of the product.

Tubercular Hospital.—Since the last report I am pleased to state we are now equipped with a hospital for this disease, and from which I feel much good will result.

Isolation Hospital.—In the matter of Isolation Hospital we are as set forth in previous reports sorely in need of more accommodation, and am trusting that in the matter of hospital extension this department will meet with due consideration.

FORT WILLIAM.

Dr. E. B. Oliver, M.O.H.

In accordance with the provisions of the Ontario Public Health Act, I hereby submit my annual report for the year ending October 31st, 1913.

The year has been a most active one for the department.

1. We have had to deal with a considerable number of cases of smallpox.

2. The number of patients treated in the Isolation Hospital have been double that of the previous year.

3. The campaign against infant mortality has been kept up.

4. The Anti-Tuberculosis Society has done much good.

5. The appointment of a qualified veterinary as Food and Dairy Inspector has been made.

6. The appointment of a foreign-speaking assistant Sanitary Inspector to act in the summer months was brought about.

7. Particular attention has been paid the production and handling of milk, including the examination of many more samples than formely.

8. The commencement of the work of laying the water main under the Kaministiquia River was brought about.

9. An incinerator has been erected.

10. The severance of the Health Visiting Nurse from the work of the Isolation Hospital and the co-operation with the schools has added to department efficiency.

11. The office of the department in the City Hall has been furnished and a laboratory established.

12. The co-operation of the physicians in the city is increasing in the reporting of cases of contagious diseases.

During the year we have had eleven cases of smallpox. This is four cases less than we had two years ago, when there was nearly an epidemic, fifteen cases having been reported and discovered. I use the latter word advisedly, for it is a notorious thing that among intelligent people cases of smallpox are being harbored and not reported to this department.

Situated as we are, where traffic from the east and west converges, chance of exposure to smallpox is great. There were, according to the Public Health Report of the Department of Washington, D.C., over five hundred cases of smallpox in the State of Minnesota last year. Our traffic with that state is greater than with any other state, both on account of the contiguity of territory and the plying between ports of the state of vessels of the Northern Navigation Co. and the United States and Dominion Transportation Co. (Booth Line).

Hence, it is not surprising that six of our cases were due to infection originally from that state.

By vigorous action on the part of your department, the cases were limited to the houses wherein they originated.

In one of the houses a case was found well advanced, and that only after a second visit of your Medical Officer of Health, a denial of the existence of any case having been made at the first visit. At this visit no other cases were observed. Later evidence warranted another search, which resulted in the finding of two more cases.

The finding of these two cases resulted in the obtaining of a summons for the proprietress.

She came before the magistrate, but was allowed to go with a warning.

Owing to causes aforementioned, it is highly possible that we will be called upon to care for several cases of smallpox during the course of each year. To do this it will be necessary to put into proper shape the old Isolation Hospital that now stands on the same lot as the new building.

Until this time we have been able to care for smallpox cases in the new building. But the ever-increasing population brings an increasing number of cases of other diseases, which will probably hereafter tax the capacity of our new building.

This has been shown this year, there having been an increase of 100 per cent. in cases at the new building.

I would urge, therefore, that in striking the estimates for 1914 an appropriation be made for the overhauling of the old building.

The annexed report of the Isolation Hospital shows that we are just one patient short of having double as many patients in the hospital as we had last year. This has been due to an increase in the number of cases and a growing knowledge of the advantage of the institution.

If the overhauling of the Smallpox Hospital is done as mentioned above there will be sufficient room in the Isolation Hospital to treat all cases of measles, scarlet fever and diphtheria that apply.

During the course of the year there was some controversy in regard to the care of those who had erysipelas. The McKellar Hospital, which has been treating such cases, decided not to do so after a certain date, and applied to me to look after them. On consultation with your Board, it was left in my hands. The position is such that we cannot accept these cases at the Isolation Hospital until some provision is made for their care. The Isolation Hospital was built to accommodate scarlet fever and diphtheria cases.

We have accepted measles and smallpox, but cannot add erysipelas to the list. While I do not urge that this Board should provide for their care, I do think some arrangement should be made.

The number of deaths of infants has been great this year, notwithstanding the earnest campaign in behalf of the little ones. As I will later deal with the milk question, which forms a considerable part of the discussion of means for the prevention of infant mortality, it will suffice here to deal with the need in the home.

The annual report of deaths of infants will show that there were seventy-five deaths during the year from ileocolitis. During July and August there were fifty-one deaths, or over two-thirds of the total number of deaths for the year.

The Visiting Health Nurse has been constantly on the job and has visited all newborn babies and their mothers, and has instructed the latter in the care of the child. But only too often the advice is disregarded. During the year the nurse made 800 visits.

Education is the root of the whole matter. By this I mean not education after the birth of the child, but education of the children who are to be mothers some day, and particularly those who are expectant mothers. For this latter it would be necessary to have a registration bureau, at which expectant mothers could leave their names and addresses. They could be visited in the home by the nurse. They could then be brought together and given instructions by the physician, after which the nurse could again visit them to see that the instructions given by the physician are carried out.

Our large foreign population makes the work for the infants very difficult as so much prejudice and ignorance must be overcome.

The Anti-Tuberculosis Society, organized two years ago, while not being of the value it should be to the community has done some good.

The Society has caused to be distributed in various languages pamphlets setting forth the danger of tuberculosis and instructing those in care of the affected ones, as well as the patient himself, in regard to the care that must be taken to prevent the spread of contagion. Spit-cups have been suplied to many at a nominal charge or no charge at all.

There is urgent need for a sanitarium or other institution to care for tubercular patients. I understand that it is the intention of the McKellar Hospital Board to apply for a submission of a by-law to increase the accommodation of the institution. If this is so, I would urge upon the Board the opportunity of endeavoring to have place in any such addition for tubercular patients.

The milk problem is one of the largest, if not the largest, with which we have to deal.

During the year I examined three hundred and fifty samples of milk for butter-fat, preservatives, temperature and specific gravity.

The butter-fat was found generally good. Our percentage for the year will average about 3.4. During the year three persons were in court for breaches of the Milk By-law. Two of these were in court twice. Each was fined five dollars and costs for the first offence and twenty dollars and costs for the second offence. The other offender was fined five dollars and costs. Four of these cases were the result of dirty milk being sold. One was for the use of preservatives.

The greatest trouble with regard to the milk problem is dirty milk, and nearly all the dirty milk consumed in the city is brought from the adjoining country. We have no means at present to stop the bringing in of this milk. I think this city is now large enough to have a man who will give his whole time to the milk problem.

We can have clean milk. The only need is a man to see that it is clean when it arrives in the city. The producers of milk in the city almost always have clean milk. They are well supervised. The milk from the country is rarely clean. They are not well supervised. The deduction is obvious.

These facts are furnished on the tests as above mentioned on three hundred and fifty samples of milk. This is over three times the number of the previous year.

Fortunately the number detected using preservatives was small.

The temperature of milk peddled during the months of June, July and August was far from satisfactory. I would suggest that this be amended to read that all peddlers must have ice on their wagons during June, July and August.

We have endeavored to educate the consumer in the care of the milk in the home, but owing to lack of facilities have fallen short of our desires.

During part of the year we have had the services of Dr. R. N. Parkhurst as Food and Dairy Inspector. Dr. Parkhurst's services were valuable, but owing to lack of co-operation I could not get things done satisfactorily, so after consultation with your Board it was decided to dispense with his services.

During the time Dr. Parkhurst was on the staff he reported the dairies as being in good condition. Mr. Stanley reports that they continue to be so.

As the Board of Education were anxious to have some commencement made of medical inspection of schools, and were willing to make an appropriation for such services, I entered into negotiations with them, with the result that one nurse acts as visiting health and school nurse.

The arrangement has worked very satisfactorily up to the present time. Unfortunately Miss Ida M. Hobbs, the original appointee, was forced to retire on account of illness. Her successor, Miss Minnie McKay, has been doing good work.

The morning is given to school work and the afternoon to health work, although this really is a misnomer, as it is all health work. I have found the school work of the nurse a very great help to me in allowing time to be spent on work that could not be done were it not for the health work being done by the nurse.

This work has been greatly helped too, by the good fortune we had in obtaining the services of Mrs. Ashby as assistant at the Isolation Hospital.

Mrs. Ashby receives a retaining fee and agrees to give her whole time to the work as she may be called upon.

Following is a report of the school nurse for the two months which are included in our year:

REPORT OF HEALTH NURSE, SEPTEMBER AND OCTOBER, 1913.

Inspections made	2,133
Cases pediculosis instructed	432
Excluded for sores on body	7
Cases suspected tuberculosis	4
Cases referred to shelter	1
Total	2,577

In several cases of tonsilitis, adenoids, carious teeth and eye trouble, reference cards sent to parents.

The furnishing of the office in the City Hall has added greatly to the usefulness of the department. This could still be further improved upon by the addition of another filing cabinet, which should be provided for in next year's estimates.

The laboratory has justified itself, as shown by the following report of the work done there:

LABORATORY REPORT.

Number samples milk analyzed	360
Number diphtheria swabs taken	26
Number sputum examinations	4
Number samples water plated	2
Total	392

This is an average of 32.8 specimens per month.

The small number of sputum examinations is due to the fact that they may be done less hurriedly, and so often are sent to the Provincial Laboratory at Toronto. Then a laboratory has been established at the McKellar Hospital. These cases are much better handled by one constantly at such work. I would therefore recommend that some arrangement be made with the bacteriologist at the hospital to do such work. The same could be done in regard to bacteriological examinations of milk, as our dirt tests cut down the need for such examinations.

I would suggest that some improvement be made in regard to the care of psychopatic cases in this city. Often weeks elapse between the making out of necessary papers and the sending of such cases to the asylum. Any increased hospital accommodation in the city might consider a ward or two for such cases.

During the year the Sanitary Inspector conducted thirty-three cases in the Police Court, as compared with sixteen for the last year, as follows:

Milk Act prosecutions	7
Breaking quarantine	2
Unsanitary conditions	24
Total	33

Of these cases nine were let off with a caution and of the remainder fines were imposed varying from $2.00 to $20.00.

Total amount of fines collected was $157.00, as compared with $39.00 last year.

In addition to the above cases actually brought to court twenty-six letters were signed by the magistrate and were sent to offenders. This procedure is often followed before a case is taken to court.

In the matter of installation of plumbing into houses, eleven cases were sent to the Council to carry out in default. Not one of these were dealt with.

Fifteen installations were made at the request of the owners, mostly in new buildings. At this rate it will be many years before the privy system is abolished.

In March last, Mr. Bryce M. Stewart, of Toronto, made a preliminary social survey of the city for certain social organizations. This department lent him such aid as they were able. We have since received a copy of his report, which is on file in the department.

We have made a house to house canvas of many dwellings in the east and west end coal dock section. This we were able to do, as we had on the staff a foreign-speaking assistant Sanitary Inspector.

Many of the dwellings visited were found overcrowded. But I am pleased to say that on the whole conditions are improving. The new ditches that have been put in on certain streets have materially helped to drain off the former stagnant water.

Our total death rate, based on the estimate of population by the Assessment Commissioner of 24,000, is 16.5 per thousand from all causes. Deducting accidental deaths, it is 14.0 per thousand. Deducting accidental deaths and still-born, it is 12.5 per thousand.

There were ten less still-births this year than last—forty-one this year as compared with fifty-one last year. I am pleased to see this. There is still room for improvement.

The number of accidental deaths is fifty-one, as compared with thirty-five last year. This is about seventy per cent. above last year and is a deplorable condition.

Last year I drew attention to the large number of accidental deaths. This year's record should result in an inquiry in an endeavor to find some method that will prevent the snuffing out of so many lives. This is an unenviable record for any city to have and is giving us considerable notoriety.

The work of the whole department, but especially that of the Sanitary Inspector, has been greatly facilitated by the use of the automobile purchased for the City Hall staff.

During the year the following have been on the staff:

Medical Officer of Health	Dr. Edward B. Oliver.
Sanitary Inspector	Mr. Walter E. Stanley.
Assistant Sanitary Inspector	Mr. Nick Banin (6 months).
Food and Dairy Inspector	Dr. R. N. Parkhurst (6 months).
Visiting Health Nurse	Miss C. McKibbon (6 months).
Visiting Health Nurse	Miss Ida Hobbs (2 months).
Visiting Health Nurse	Miss Minnie McKay (2 months).
Superintendent Isolation Hospital	Miss M. E. Duncan.
Asst. Superintendent, Isolation Hospital	Mrs. Ashby.
Janitor, Isolation Hospital	Mr. S. Fitton.
Plumbing Inspector	Mr. S. Macnamara.
Stenographer	Miss Agnes McDonald (2 months).
Stenographer	Miss Mabel Mitchell (9 months).

I desire to thank your Board for the co-operation shown in the work of the department, both for myself and the members of the staff.

Garbage, Refuse and Nightsoil Collection and Disposal.

The garbage and refuse are to be collected in two-wheel carts of 2 cu. yd. capacity. The nightsoil will be collected in the old manner.

The whole is to be hauled by teams to loading stations and the incinerator.

The loading stations are being erected, one at Young Street, just south of Empire Avenue, and one on Walsh, just east of Tarbutt Street.

At the loading stations special street railway dump cars will be located to receive the garbage, refuse and nightsoil. These cars will be hauled to the incinerator daily.

The incinerator is located on Athabasca Street, near the inter-city boundary. It is a high-temperature plant, capable of dealing with fifty tons of matter per day. The garbage, etc., is hauled to the top of the building and dumped through openings to a

storage hopper, and darkened to prevent excessive fly nuisance from the storage hopper. The garbage, etc., is raked into the furnaces.

The furnaces are top-fed type, with water-sealed feeding doors. To charge the furnace the feeding-door is elevated by balance weights and a hinged hopper is lowered over the hole. The garbage, etc., falls on to a sloping dry hearth at the rear of the furnaces.

From the drying hearth, the garbage, etc., is raked on to the fire bars until burned to clinkers. The front guillotine-pattern door is then raised and the furnace clinkered, the clinkers falling into special dump rail cars.

The furnaces are worked by hot-air blasts, the air being heated at the regenerator and a blower forcing the air through ducts into the ashpit under the fire bars.

A combustion chamber and the three furnace cells all intercommunicate from the battery.

An animal chamber is formed at the change of direction in the flue. The chimney is eighty feet high.

Provision is made for a boiler to be added in the future.

The cost of the plant, including the land, is approximately twenty thousand dollars.

GENERAL EXPENSE ACCOUNT.

Department of Health.

Salary of Sanitary Inspector		$1,200 00
Salary of Medical Officer of Health		1,000 00
Salary of Superintendent Isolation Hospital		800 00
Salary of Health Nurse		550 00
Salary of Assistant Sanitary Inspector		450 00
Salary of Stenographer		420 00
Salary of Food and Dairy Inspector		300 00
		$4,770 00
Expenses of office at City Hall		1,705 00
Isolation Hospital maintenance		1,969 35
Total cost department		$8,444 35
Credits.		
Police Court fines	$157 00	
Milk licenses	20 00	
Isolation Hospital collections	214 00	
Total		391 00
Net cost of department		$8,053 00

Isolation Hospital Account.

Maintenance Account	$1,201 00
Salary of Superintendent	800 00
Salary of Assistant nurse (part)	330 00
Salary of Janitor	600 00
Salary of other nurses	618 35
Insurance	150 00
Total cost	$3,699 35
Credits.	
Total collection Isolation Hospital accounts	214 00
Net cost	$3,485 35

Number of hospital days	1.167
Average cost per patient per day	$2.83
Total smallpox days	269
Total extra cost	$150.00
Total extra cost per day	.55
Total cost smallpox per day	3.38

Isolation Hospital Annual Report.

	November, 1912-October, 1913.
Diphtheria patients	15
Scarlet fever patients	22
Measles patients	8
Smallpox patients	12
Total patients nursed	57
Diptheria, days	199
Scarlet fever, days	568
Measles, days	74
Smallpox, days	269
Special nurses	46
Mother nursing	11
Total number hospital days	1.167
Antitoxin used	161,000 units

GUELPH.

Dr. H. O. Howitt, M.O.H.

I beg to submit to you a brief report for the year ended November 30th, 1913.

Mortality.

Two hundred and thirty-six deaths occurred and were reported during the year. A number of these were patients from a distance seeking health in the local hospitals and sanitarium.

Dividing these into decades of ten years, and the first decade subdivided into two sections, from birth to two years of age, which gives the infant mortality, and two to ten years of age, and a further subdivision made up of still-births, we find that of the 236 deaths there were reported as still-born 14.

Between the ages of 1 day and 2 years there were	46	deaths.
" " 2 and 10 years there were	6	"
" " 10 and 20 " "	3	"
" " 20 and 30 " "	13	"
" " 30 and 40 " "	17	"
" " 40 and 50 " "	18	"
" " 50 and 60 " "	25	"
" " 60 and 70 " "	23	"
" " 70 and 80 " "	43	"
" " 80 and 90 " "	22	"
" " 90 and 100 " "	6	"

Upon looking into the causes of death we find of the total number, diseases of the nervous system claimed 32; diseases of the digestive system, 30; diseases of the cardio-vascular system, 56; diseases of the genito-urinary system, 16 (7 of which were nephritis, and 3 of which were cancer); diseases of the respiratory system, 36 (of which 25 were pneumonia and 9 due to tuberculosis). The infectious diseases: Measles, 1; typhoid, 1; scarlet fever, 1; whooping cough, 1; influenza, 1, and, as before mentioned, tuberculosis, 9.

There were three deaths attributed to acute alcoholism, and ten deaths were accidental or suicidal.

There were 16 deaths due to cancer, 12 of which were of the digestive system.

Seven deaths were due to peritonitis, one of venereal origin, three of diabetes, one of gall stones, and a number were of rare origin or hard to classify.

Infectious Fevers.

There were reported to this board 17 cases of diptheria, 27 cases of scarlet fever, 102 cases of measles, 58 cases of chicken-pox, 1 case of whooping-cough, 1 case of small-pox, and 9 cases of typhoid fever. Of the nine cases of typhoid fever one was infected from another case, one contracted out of town, two were from well water, and five untraceable.

The Water Supply.

In my last report I drew attention to the danger of infection of our water supply where the main pipe runs to the reservoir through St. Patrick's Ward. With the building of factories and the increasing number of houses in that district there will soon be very great danger. With one case of typhoid in the near vicinity of this pipe it would be possible, with a leak in that pipe, to endanger every house in Guelph.

The Provincial Board of Health, at my request, sent up their engineer, who made certain recommendations for the preservation of the purity of our water supply. These recommendations will be rigidly enforced. Nothing short of a sewerage system for St. Patrick's Ward will ensure the safety of Guelph's water supply. There are upwards of 150 hands employed at the malleable iron plant alone. There is no sewage disposal there, a system of cesspools being all that is available. The rock formation only permits cesspools of four or five feet in depth. With the spring floods the accumulations of months are released and distributed towards the river, threatening the main pipe.

Sewerage for St. Patrick's Ward is in my opinion the biggest problem we have to deal with.

Medical Inspection in Schools.

There is a growing tendency throughout the country towards medical inspection of school children. As a start in Guelph I would suggest the recommendation of the employment of a school nurse, a hospital graduate, whose judgment would be exercised to decide when a child should be sent home from school and not allowed to return without the certificate of a medical man. She could give instruction on the transmission of infectious diseases, take temperatures when necessary, and might in the summer holiday months be of great value to mothers unable to afford the expense of a nurse, in giving advice on dieting children with intestinal diseases. In another Ontario city this idea has been carried out with splendid success, the nurse working in conjunction with the Board of Health.

KINGSTON.

Dr. A. R. B. Williamson, M.O.H.

I beg leave to submit herewith my Annual Report. During the course of the year some progress has been made in matters of public health, but a large amount of work still remains to be accomplished before conditions are satisfactory.

From November 15th, 1912, to November 15th, 1913, there were reported to me 34 cases of typhoid, 28 cases of measles, 18 cases of scarlet fever and 56 cases of diphtheria. Of the typhoid cases, six were infected before coming to Kingston, and of the remainder eight originated last August in the neighborhood of Russell Street, where a city sewer opens into an old water-course which runs through two pasture fields. In the absence of infection in city water at that time, these cases were attributed either to direct infection of milk or to fly-borne infection; in both cases originating at this water-course. Those pasturing cattle in these fields were ordered to find other pastures, and daily disinfection of the water-course by means of chloride of lime was kept up until the fly season was over. The Board of Health immediately ordered the construction of a sewer to obviate the menace to health of the conditions existing there, and construction is now well under way.

In order to more efficiently chlorinate our supply of drinking water, the Board recommended the purchase of two injectors, which are now being installed, and which it is hoped will insure a more even process of chlorination and less danger from typhoid infection.

There have been several cases of scarlet fever and diphtheria, as usual. These cases are largely due to contact with mild unrecognized cases, and it seems very difficult to avoid this type of contagion. One child has apparently a slight sore throat, which

clears up rapidly. In a few weeks there are several cases of diphtheria in that neighborhood, and when the suspected source is examined the child may be free from infection. The only way to overcome this difficulty is to have a swab from every case of sore throat cropping up in the schools examined, as it is generally in the schools that a mild contagion will give rise to a serious outbreak.

The efforts of the school nurse have been of great service in this matter, and while we regret that we still have cases of infectious diseases, some of them fatal, we may be sure that only for the care exercised by the nurse in the examination of school children we would have many more cases to regret.

In order to facilitate examination of such suspected cases, I propose to lay before the Local Board at an early meeting a plan to have properly prepared sterilized swabs, sputum bottles, bottles for water and milk analysis, etc., placed at two convenient points easy of access, so that at any hour of the day or night a physician may be able to obtain apparatus for taking specimens from suspected cases. The cost will be comparatively trifling, and is not to be considered when it is remembered that even the saving of one life in a year by thus facilitating rapid examination and report on suspected cases would justify many times the outlay. Similar methods have been adopted by all cities where an attempt has been made to scientifically fight disease, and should be done so here.

There has undoubtedly been a large number of measles cases unreported. Many cases never see the doctor until the illness is over and the patient applies for a certificate to enable him to return to school. As the work of Andeson, of the Public Health Service at Washington, goes to prove that the really dangerous period in measles infection is the early stage before the rash is out and possibly for twenty-four to forty-eight hours after that time, a revision of our regulations regarding this disease may have to be made in the near future. Such revision has already been made in New York City, Chicago and Asheville, N.C.

Many complaints of various kinds have been dealt with during the year. Some of these were complaints regarding unsanitary cellars and a few regarding unsanitary condition of building, due to overcrowding. At the present time these cases are considered individually and alterations ordered when it is apparent that there is a menace to health. It would be better, however, to have our Building By-laws revised to conform to modern sanitary views, and then such conditions as now exist would be prevented automatically and not allowed to reach the stage o being a menace to health before they can be corrected. Such laws should, if possible, be made retroactive. In order to properly enforce such regulations, the city must be prepared to extend water mains and sewers to all parts within its borders, as without these things it is impossible to have sanitary buildings.

LONDON.

T. V. Hutchinson, M.O.H.

I beg to submit a report for the Board of Health for the year 1913.

Carling Creek.—This creek question is perennial. Fewer complaints however, were received this year than usual. A deputation addressed the Board on June last, asking that steps be taken to have the nuisance abated, and your Board investigated, but found little room for complaint. It is expected that when the storm sewer system is constructed that the cause for complaint will be removed.

Garbage.—A garbage collection system has been established and an incinerator erected at the foot of Waterloo Street. The Board of Works is to be congratulated upon its successful initiation of this public utility. It is but fair to state that the few causes for complaint will be removed as the system of collection becomes more perfect.

Nuisances.—Complaint from Mr. Frank J. Baer in regard to a nuisance existing between Anderson Avenue and Pegler Street was received by your Board. This question was referred to the Provincial Board of Health, after an attempt had been made to induce the ratepayers interested to abate the nuisance. The work was done by the Provincial Department at a cost of $578.00, and the ratepayers interested will be called upon to pay the cost.

A. J. Kibbe and others complained of a nuisance at Wellington and Piccadilly Streets. The City Engineer reported that the dumping of garbage at this section of the city has been forbidden, and an action brought by one of the ratepayers in the neighborhood, claiming that this dump was the cause of an infectious disease in his family, was, I understand, not successful. The Medical Health Officer reports that there are few public dumps in the city, and that they are reasonably well cared for.

Inspector Lutman reports that the rendering works in the east end was kept as clean as possible.

The Inspector had ordered the removal of slaughter-houses and prevented the keeping of hogs in the city. The butchers and keepers of slaughter-houses have been sent copies of Clause 100 of the Public Health Act, providing that, "When blood, offal, or meat of any dead animal, which has not been previously boiled or steamed when fresh or before becoming putrid or decomposed, or which, although boiled or steamed, is putrid or decomposed, has been or is being fed to hogs, he may seize and carry away the hogs," and the Medical Health Officer has been instructed to enforce this law.

Market House.—Improvements have been made by No. 3 Committee in the sanitary arrangement of the Market House. The Medical Health Officer states that the practice of grinding bones, rendering tallow and other offensive practices have been discontinued, and the sanitary conditions are now very satisfactory.

Sanitary Inspection.—Inspector Lutman reports that the condition of the city is very satisfactory.

Water and Ice.—The Medical Health Officer has been instructed to secure an examination of the city water once a month. The Water Commissioners also have at frequent intervals tested the water. Your Board is pleased to state that in every case the city water has been declared absolutely pure.

The ice supply was reported unfit for domestic use, but Cove ice was declared "probably safe, and might be used without restriction." The ice supply does not appear satisfactory.

Milk By-law.—The milk supply for the city of London has been reported satisfactory by Inspector Tamlyn.

Maternity Homes.—The Act relating to private hospitals and maternity homes requires that a medical man or a graduate hospital nurse be in attendance. Under the instructions of the Provincial Board, the maternity homes in the city have been closed, with the exception of one. The Medical Health Officer reports that this home in the city is well regulated.

Food By-law.—At the first meeting of this Board the question of the sale of food unfit for human consumption was taken up by your Board. We are unanimously of the opinion that it is absolutely necessary to have all cattle properly inspected before and after killing by a Government inspector. The result of inspection at the Abattoir has been such as to convince the members of the Council and of your Board of the truth of this statement. Tubercular meat is sold, as well as meat from animals suffering from other diseases. Your Board have, therefore, urged upon the Council the necessity of passing a by-law which will enable the local Board of Health to demand that all meats sold in London be properly inspected by the Government Inspector, and to prohibit the sale of any meats within the city limits that does not bear the Government stamp. The Medical Officer of Health has been entrusted to enforce the provisions of the Public Health Act with respect to the sale of meats.

Riverview and Carfrae Crescent Sewers.—Petitions have been received for sewers on Riverview Avenue and Carfrae Crescent. The Engineer's Department report it is practically impossible to construct sewers on these streets unless sewerage be permitted to flow into the river. Your Board, therefore, is of the opinion, since the Provincial Board wisely refuses to allow this, that steps should be taken to construct sewers on these streets provided with some practical sewerage disposal plant.

The question is under consideration by the Provincial Board, and it is hoped that some solution of the difficulty will shortly be arrived at.

Overcrowding of Houses.—Your Board took up the question of overcrowding of houses. In the southwest portion of the city some houses were closed, and in all cases cleaning up of premises and sanitary conditions have been enforced. Here again the Public Health Act gives your Board ample power, and continuance of these nuisances is within the power of the Building Inspector and the officers of public health.

Street Cars.—The attention of your Board has been called to the unsanitary condition of a number of the street cars. The Medical Officer has taken the question up with the London Street Railway, and he reports a much improved condition.

Sewers.—Your Board has recommended the construction of seventeen sewers on sanitary grounds, and in each case, I understand, the Council has undertaken the work by the necessary two-thirds vote. Your Board caused a copy of a resolution, urging upon the Council of the Corporation to construct a storm sewer system to relieve the domestic sewers and to prevent flooding of cellars in various portions of the city, to be printed in the papers.

We congratulate the citizens upon the splendid vote in favor of a storm sewer system. We are now looking to the Council for action on this question.

District Officer.—Dr. Bentley, the District Officer of Health, has placed his services at the disposal of your Board, and in enforcement of provisions of new Public Health Act, Dr. Bentley's assistance will be of immense advantage.

Street Cleaning.—On three occasions your Board called the attention of the Council to the unsatisfactory practice of sweeping the street refuse into the gutters. Some improvement must be made or steps should be taken by the Board to improve the system.

Officers.—I take this opportunity to thank my colleagues for their attendance and interest in the work of the Board. The reduction in number under the present Act has necessarily increased the responsibility and the demands on the time of the members. In all matters the Board has been a unit and much work has been accomplished.

The officers of the Board have been zealous in the discharge of their duties.

Fourteen meetings have been held, and the attendance of the members was as follows, viz.: W. H. Abbott, 14 meetings; T. VV. Hutchinson, M.D., 14 meetings; F. L. Burdon, M.D., 13 meetings; J. R. Haslett, 13 meetings; C. M. R. Graham, Mayor, 4 meetings.

I submit herewith report of the Medical Officer of Health, and have refrained from discussing the question of general health of the city. That question will be dealt with by him.

All of which is respectfully submitted,

F. L. Burdon, M.D.,
Chairman.

London, Ont., December 1st, 1913.

To the Mayor and Aldermen of the City of London:

Gentlemen,—I herewith submit my annual report for the year ending November 15th, 1913.

There were 794 deaths, exclusive of 26 still-born, which are not counted in mortuary statistics.

During the last four years the number of deaths caused by pneumonia has exceeded that of any other single disease. In 1910 there were 54 deaths from this cause, in 1911 there were 53, in 1912 there were 50, and in 1913 there were 82, all principally among the aged and those past the noon of life.

Fifty-nine deaths were due to tuberculosis of the lungs. This does not include its many complications, such as tubercular meningitis, or tubercular disease of the bones and joints. The disease is not increasing in the same ratio as the population. In 1909 there were 40 deaths; 1910, 42; 1911, 45, and 1912, 37.

Cancer is third on the list with 42 deaths, and is becoming more prevalent year by year, not only in this city but through the entire province.

Twenty deaths were caused by violence, such as suicide, railway accidents and poisoning.

There were 10 cases of diphtheria, with 2 deaths.

Typhoid fever, a preventable disease, generally contracted from impure water and unsanitary conditions, is conspicuous by its almost entire absence, causing but two deaths, the lowest in many years. This speaks well for the sanitary state of the city and for the purity of our water.

The death rate for the year was 13.23 in the 1,000 of population.

The inauguration of a system of garbage collection commenced in July is not only a boon to the citizens, but a very great aid in maintaining the public health. There are now 18 carts and 7 teams employed in the collection. Over 50 tons of garbage, ashes and refuse are collected every 24 hours and destroyed in the incinerator, which was formerly deposited in back yards and dumps. Mr. Dodd, the superintendent, is doing all that can possibly be accomplished with the means at his command. Sixty tons a day could be collected in the city, but that would mean more teams, men and expense. Some dwellings are occasionally passed over. People should not be too exacting, however, for sometimes this is unavoidable. The system is improving from day to day. The department is now making approximately 22,000 calls per week.

The Dominion Abattoir Company, in East London, is another boon to the citizens, and is doing excellent work in the conservation of public health. Here all cattle, hogs and sheep are inspected by the government inspector both before and after killing. To show the importance of a proper meat inspection, I will give you a few figures from their records, as follows:

From June 1st to the present time, 5½ months, there were 734 cattle killed. Of this number 65 were found to be affected with tuberculosis. That is nearly 9 per cent.; 9 of the 65 head were totally condemned, and put in the grease tank. The remaining 56 were only affected in parts, such as the lungs and viscera, which portions were ordered destroyed by the inspector. We eat tuberculous meat and feed tuberculous milk to our children, and then we build hospitals and sanitariums to fight the disease.

Three thousand three hundred and thirty-three hogs were killed during the same period. Of this number 789 were found affected with tuberculosis, or 23.69 per cent.

Twelve of the 789 hogs were wholly condemned, and also put in the grease tank. The remainder were affected in parts only, principally in the heads and viscera, which were likewise destroyed under the supervision of the Government Inspector.

The same may be said of market milk. If 9 per cent. of the beef cattle killed, as already stated, showed tubercular infection, is it not reasonable to believe that the same conditions would exist in the dairy herds? At the present time there are about 150 dairies supplying the city. In winter the number may reach 200. Of all these herds only two have been reported as having regularly received the tuberculin test for consumption, viz., the Cedar Terrace Dairy herd, supplying Victoria Hospital, and Wm. Piper's herd, supplying St. Joseph's Hospital and Mount Hope Orphanage.

The Byron Sanatorium keeps its own herd, and applies the tuberculin test.

All milk from dairy farms should come from tuberculin-tested cattle. Otherwise, all milk should be pasteurized, that is, heated to a temperature not less than 140 degrees Fahrenheit for twenty minutes, then immediately cooled to 40 or 45 degrees.

A detailed report of the inspection of herds and dairies and the quality of milk supplied the city will be published as soon as the work is completed.

All of which is respectfully submitted,

T. V. Hutchinson,
Medical Officer of Health.

OTTAWA.

Dr. T. A. Lomer, M.O.H.

I have the honor to submit to you the Annual Report of the Health Department for the year ending October 31st, 1913. This report includes the reports from the heads of the various sub-departments. Dr. Shirreff held the position of Medical Health officer until July 1st, and afterwards remained with me for two months in an advisory position.

The estimated population is	100,000
Total number of births	2,638
Birth rate, 1913	26.38 per 1,000
Birth rate, 1912	23.98 per 1,000
Birth rate, 1911	22.83 per 1,000

This shows a steady increase in the report of births, but does not, I believe, give any reliable information as to an increased birth rate, because even yet a large number of births are not reported.

Total deaths, 1913	1,891	
Still-births	157	
Deaths of non-residents	206	
Corrected total deaths	1,528	
Death rate		18.91 per 1,000
Corrected average death rate for 1913		15.28 per 1,000
Corrected average death rate for 1912		14.14 per 1,000
Corrected average death rate for 1911		15.86 per 1,000

Communicable Diseases.

The total number of communicable diseases reported and the deaths therefrom were as follows:—

Communicable Diseases Reported During the Year.

Diseases.	1912. November.	1912. December.	1913. January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	Cases.	Deaths.
Typhoid fever....	10	2	2	9	2	7	1	5	8	22	24	26	118	20
Tuberculosis	11	13	8	10	12	19	14	11	7	4	8	2	119	138
Small-pox	3	11	16	16	8	10	11	3	6	2	2	2	90	
Diphtheria	41	45	47	26	33	29	44	15	21	16	26	35	378	40
Whooping cough..	....	....	....	8	......	4	1	....	1	5	1	....	21	17
Chicken-pox......	5	4	9	5	2	6	4	1	1	1	1	6	45	1
Measles..........	3	6	21	178	428	282	170	38	6	1	1	9	1,143	17
Scarlet fever	5	6	40	14	18	16	21	14	21	21	14	30	220	8
Erysipelas	....	....	....	1	3	1	1	....	1	....	....	1	8	3

Deaths from Communicable Diseases by Wards.

—	Small-pox.	Diphtheria.	Scarlet fever.	Whooping cough.	Measles.	Typhoid fever.	Chicken-pox.	Total.
Ottawa	....	3	....	4	4	3	....	14
By	....	2	....	....	2	....	....	4
Rideau	....	1	....	3	5	....	....	9
St. George...........	....	23	8	....	1	6	....	38
Wellington...........	....	2	....	1	1	....	....	4
Central	....	....	....	5	1	2	1	9
Capital	....	....	....	1	1	....	....	2
Dalhousie	....	2	....	3	1	1	1	8
Victoria.............	....	2	....	3	2	2	....	9
Outside..............	....	3	....	....	....	6	....	9
Totals	....	38	8	20	18	20	2	106

Pulmonary Tuberculosis.

During the year there were 138 deaths from tuberculosis, 122 cases being pulmonary and 16 of other forms of tuberculosis. The mortality rate was 13.8, or 12.2 per pulmonary tuberculosis alone. Of these 40 deaths occurred at the Lady Grey Hospital and 17 cases were of non-residents.

It is to be regretted that the cases of tuberculosis are not being notified to the Department of Health as they should be. There were during the past year 19 more deaths reported from tuberculosis than cases notified.

Deaths from Tuberculosis.

Wards.	Pulmonary Tuberculosis.	Other cases.	Totals.
Ottawa	17	2	19
By	7	1	8
Rideau	4	1	5
St. George	10	......	10
Wellington	14	3	17
Central	6	......	6
Capital	7	2	9
Dalhousie	38	5	43
Victoria	4	......	4
Outside	15	2	17
Totals	122	16	138

The good work being done by the Lady Grey Hospital, the Anti-Tuberculosis Association, and the May Court Club Dispensary, is deserving of great praise and merits the support of the citizens.

Typhoid Fever.

During the year there were reported 118 cases of typhoid fever, with 20 deaths. Of these 20 deaths 6 occurred in non-residents who had acquired the disease outside the city. During the past year typhoid fever has not occurred in anything approaching an epidemic form—a fact that is largely to be attributed to the hypo-chlorite treatment of the water supply and the numerous daily tests which have been made of the water. Figures for 1912 were 1,378 cases of typhoid fever reported, with 91 deaths.

Smallpox.

There were 90 cases reported during the year, with no deaths. The Hopewell Hospital has only been empty on two occasions, and only for a day at a time. Most of the cases have been of a mild type. The Hopewell Hospital has proved extremely useful and a very valuable means of checking the spread of the disease in the city.

The report of the Hopewell Hospital from date of opening, February 4th, 1913, to October 31st, 1913, is as follows:—

Number of patients transferred to Hospital on opening	16
Discharged	78
Died	0
In Hospital October 31st, 1913	2
Admitted with smallpox	83
Admitted with chickenpox	2
Admitted from quarantined houses for treatment of other diseases	7
Total number of nursing days	1,565
Average days' stay of patients	18.8
Average daily number of patients	5.8
Cost of maintenance	$4,076.70
Cost per nursing day	$2.60

Of a total number of 83 patients admitted with smallpox, three had scars showing previous successful vaccination—one 25 years, one 35 years, and one 37 years previously.

Diphtheria.

This has been of a more severe type during the past year. Three hundred and seventy-eight cases were reported, with 40 deaths, as compared with 401 cases, with 30 deaths, during the previous year.

Scarlet Fever.

There was a slight increase in the number of cases reported, 220, as compared with 192 of the previous year, and a considerable increase in the severity of the type of disease. Eight deaths occurred, or a death rate of 3.63, as compared with a death rate of 1.04 during 1912.

Measles.

This disease occurred in an epidemic form during the months of February, March, April and May, during which time 1,058 cases were reported; total number for the year being 1,143, with 17 deaths.

Isolation Hospital.

The report for the Isolation Hospital is as follows:—

Admissions:		
Diphtheria	343	
Scarlet Fever	176	
Scarlet Fever and Diphtheria	17	
Scarlet Fever and Rubella	1	
Diphtheria and Whooping-cough	1	
Diphtheria and Measles	4	
Diphtheria and Chickenpox	1	
Measles	1	
Erythema Multiforme	1	
Bronchitis	1	
Quinsy	1	
Tonsilitis	3	
	549	
Total days' stay	14.090	
Average number of patients per day	38.6	
Deaths:		
Diphtheria	31	9%
Within 12 hours of admission	7	
Within 24 hours of admission	2	
Within 48 hours of admission	3	
	12	
Net death rate		5.5%
Scarlet Fever	4	2.3%
Scarlet Fever and Diphtheria	4	23.5%
Within 24 hours of admission	1	
Net death rate		17.6%
Total deaths	39	7.1%
Within 48 hours	13	
Net death rate		4.7%
Intubations performed	44	
Patients intubed	22	
Shortest duration of intubation	7 hours recovery.	
Longest duration of intubation	4 days recovery	
Greatest number one patient	14 days recovery	
Youngest patient intubed	6 months recovery	
Oldest patient intubed	7 years recovery	

Deaths after intubation	8
Death rate	36.4%
Antitoxin used during year	3,767,000 units
Smallest dose given	500 units
Largest dose given	30,000 units
Average dose given	9,000 units

Mixed Infections.	Developed in Hospital.	Contracted in Hospital.
Diphtheria	0	8
Scarlet Fever	2	0
Measles	1	15
Chickenpox	1	2
Rubella	3	17

A large proportion of scarlet fever patients admitted have been found to carry K.L. bacilli. Unceasing care in examination of cases has enabled us to detect the majority of these on admission, but with the accommodation at our command for the isolation of patients when admitted, this has been most difficult. Since the scarlet fever wards were cleaned and disinfected in February last, only one patient in same has contracted diphtheria, although cultural examinations of throats and noses of patients in these wards have shown presence of K.L. bacilli in a small percentage of convalescents.

Age and Sex Incidence of Diphtheria and Scarlet Fever.

—	Diphtheria.		Scarlet Fever.	
	Male.	Fem .	Male.	Female.
Under 1 year	10	4	...	...
1 year	7	9	2	2
2 years	10	5	5	5
3 "	14	11	5	5
4 "	10	16	9	6
5 "	10	10	10	10
6 "	14	18	5	8
7 "	9	16	8	5
8 "	11	7	11	9
9 "	10	7	9	4
10 "	3	14	5	5
11 "	9	2	2	2
12 "	8	6	1	3
12–15	3	11	5	10
15–20	6	19	7	8
20–30	14	28	4	5
Over 30	2	10	1	0

There is a slight decrease in the number of diphtheria cases admitted, with an increase in scarlet fever. The death rate in both is higher than formerly, the percentage of delayed cases in diphtheria being higher this year. Scarlet fever shows a very marked increase in severity; this would be even more evident if the figures for November and December were included. Complications have been frequent and severe. Of nephritis, formerly a rare complication here, there have been eleven severe cases, one resulting fatally. Previous to this year, only one mastoid operation had been necessary in ten years; this year eight cases, two diphtheria and six scarlet fever, have required operation—one of which resulted fatally.

Some repairs and improvement have been made in the Hospital this past year, and more equipment has been purchased, but much remains to be done. The remaining wards on both sides should be repainted and the plaster patched. The annex, base-

ment and nurses' floor should all be painted. The laundry is under consideration at present. It is to be hoped that the Board of Health will decide to erect a new building for that purpose. The Chief of the Fire Department will present a report advocating a number of changes which will render the building more nearly fireproof.

INFANT MORTALITY.

Total deaths under 1 year	545
Deaths of non-residents under 1 year	50
Deaths of premature infants	77
Corrected total deaths under 1 year	418
Total deaths under 1 year	206.59 per 1,000 births
as compared with	213.35 in 1912
and compared with	269.59 in 1911
Deaths of infants under 1 year per 1,000 births, excluding non-residents and premature	158.45

This infant mortality rate is still very high. It is partly accounted for by the size of the institutions caring for infants, which is very large in proportion to the population of the town. This means that a large number of infants are brought in from the surrounding country and even from towns at a considerable distance. During the year one of these large institutions, which had a high mortality rate and was found unsuitable for an infants' home, has been closed down. In order to efficiently control importation of infants from outside municipalities it would be necessary to have an official who could spend a considerable amount of his time in the supervision of the admission, discharge and adoptions of such institutions. The question of adopting out orphans or abandoned infants is very important, as many of these are sent to private homes where they are improperly cared for, and afterwards are either returned to the institutions in a hopeless condition or die. We are at present co-operating with the Provincial Board of Health with a view to restricting these evils.

The work done by the Infant Milk Stations, in charge of Miss Moore, has done a great deal in assisting to keep down the infant mortality in the poorer sections of the town, and I hope to have this work continued and enlarged. The report of the work done by the Infant Milk Stations will be incorporated in this report.

MEDICAL INSPECTION OF SCHOOLS.

A start has been made along these lines by the appointment by the Public School Board of two visiting nurses who make regular inspections of all the public schools, and have proved of much assistance to the Department of Health in finding carriers of scarlet fever and diphtheria, as well as assisting in the elimination of ring-worms and other contagious diseases. It is to be hoped that the Separate School Board will adopt the same means, and that the number of nurses at present employed will be increased. It would also be advisable to have qualified practitioners appointed as Medical School Inspectors, as is done in most of our cities.

CIVIC LABORATORY.

The work of the laboratory was carried on in the old premises in the City Hall until the month of August, when the work was transferred to the new laboratory on Slater Street. This new laboratory is well designed and completely equipped, and affords good facilities for water and milk analyses and for all the other work in connection with the Department of Health.

During the latter part of the year Mr. Rice, the Assistant Bacteriologist, resigned, and was replaced by Mr. W. H. Shuff.

The report of the work done at the civic laboratory is appended.

PLUMBING INSPECTION.

The need for a revision of the Plumbing By-law, which was emphasized by our Chief Sanitary Inspector in his last year's report, has been taken up by a committee appointed by the Board of Health and the by-law remodelled. This will be submitted for approval at an early date. The time of the two plumbing inspectors is so much occupied in the inspecting and testing of new plumbing that much of the work of inspecting old premises devolves on the Sanitary Inspector's staff.

The report of the Chief Plumbing Inspector is appended.

Food and Dairy Inspection.

The dairies supplying milk to Ottawa are in a very satisfactory condition, owing to the constant supervision and advice of Dr. J. B. Hollingsworth the Chief Food Inspector.

In connection with the meat supply, I would emphasize the need for a municipal abattoir, without which no satisfactory inspection of meat can be made at the time of slaughter, and which is the only way diseased meat can be kept out of the city. The report of the Chief Food Inspector is attached.

Sanitary Inspection.

One of the chief difficulties of the sanitary inspection staff is in connection with the rapid building of small houses in unsewered areas. Many of these houses consist of one or two rooms and are unfit to put improvements in after the sewer has been laid.

Good work has been done during the past year in effecting the removal of outside privies from sewered areas, and with the opening of the West End Drainage System in the spring, the number of these will be still further reduced.

Many stables have been remodelled and improved during the year, but much remains to be done along these lines. The question of defining stable areas is at present under consideration and will prove a further advance in the sanitary condition of the city.

The report of the Chief Sanitary Inspector is appended.

Garbage and Refuse Collection.

The collection and disposal of garbage is becoming a very important question, and the present incinerator is unable to handle the entire amount. I would strongly urge the construction at an early date of another high temperature incinerator in the western part of the city. The present method of burning a portion of indiscriminately mixed garbage and refuse, and dumping the rest within the town limits can only be regarded as a temporary means of disposal, and an immediate provision should be made for incinerating the entire amount.

I append the tables of mortality statistics for the year of 1912.

During the year there were 1,891 deaths reported, of which 979 were male and 912 female.

Deaths by Nationalities.

Canadian	947
French-Canadian	686
Irish	83
Scotch	26
English	72
Italian	8
Jews	3
Pole	1
American	25
Others	40
Total	1,891

The mortality statistics of the different institutions in the city are as follows:—

Ottawa Maternity Hospital	22
Salvation Army Rescue Home	5
Lady Grey Hospital	40
County of Carleton General Protestant Hospital	140
St. Luke's General Hospital	55
Water Street General Hospital	115
Misericordia Hospital	67
House of Bethlehem	70
St. Patrick's Home	15
St. Charles' Home	36
Perley Home	6
Old Men's Home	4

CHIEF FOOD INSPECTOR, J. B. HOLLINGSWORTH.

I hereby beg to present my Annual Report for the year ending October 31st, 1913, covering work done in the Food Inspection Branch of the Department, and in which I have been assisted by Mr. D. R. McDonald, Mr. C. Booth, and Mr. S. Fee.

During the year the dairies have been inspected regularly by Mr. Fee and myself. In most cases we find the dairymen doing their utmost to have a good, wholesome milk and a low bacteria count. In cases where we find the count exceptionally high, we at once investigate, where we generally find carelessness in the proper washing of the milking utensils, or neglect to immediately place the cans of milk in ice water after it is drawn from the cow. These are immediately remedied and when the next sample is taken we find a great improvement.

Steady progress has been made in providing more modern and up-to-date dairy barns, with cement floors, a sufficient space of air, window space, and also a proper system of ventilation. In some cases a few of the old barns have been remodelled, giving a better window space and consequently more light. In the case of new barns, there has also been provided an up-to-date milk house, where the milk is placed in ice-cold water, after being drawn from the cow, until the time comes for it to be taken to the consumer in the city.

Fifteen hundred and twenty-four samples were collected in the year, these being tested for butter fat, total solids, and also bacteriologically. One sample of cream was found to contain formaldehyde for preserving purposes. This was used for making ice cream and the party was summoned to court and fined.

During the year the results of the different analyses of milk have been given to the Board of Health at intervals of every three months. The results for the different milk analyses are as follows:—

RAW MILK.

November 1st to April 30th.	
Number samples collected	193
Aggregate number of	5,255,100 bacteria
Average count	27,229 bacteria per c.c.
May 1st to October 31st.	
Number samples collected	447
Aggregate number of	211,695,900 bacteria
Average count	473,595 bacteria per c.c.
Whole Year Together.	
Number samples collected	640
Aggregate number of	216,951,900 bacteria
Average count	338,986 bacteria

CERTIFIED MILK.

November 1st to April 30th.	
Number samples collected	102
Aggregate number of	702,600 bacteria
Average count	6,888 bacteria per c.c.
May 1st to October 31st.	
Number samples collected	104
Aggregate number of	1,663,150 bacteria
Average count	15,992 bacteria per c.c.
Whole Year Together.	
Number samples collected	206
Aggregate number of	2,365,750 bacteria
Average count	11,485 bacteria per c.c.

PASTEURIZED MILK.

November 1st to April 30th.	
Number samples collected	17
Aggregate number of	90,500 bacteria
Average count	5,323 bacteria per c.c.
May 1st to October 31st.	
Number samples collected	49
Aggregate number of	907,000 bacteria
Average count	18,510 bacteria per c.c.
Whole Year Together.	
Number samples collected	66
Aggregate number of	997,500 bacteria
Average count	15,114 bacteria per c.c.

Butter Fat.

November 1st to April 30th.	
Number samples collected	677
Aggregate	2490.6
Average butter fat	3.7 for 6 months
May 1st to October 31st.	
Number samples collected	847
Aggregate	3549.3
Average butter fat	4.2 for 6 months
Whole Year Together.	
Number samples collected	1,524
Aggregate	6039.9
Average butter fat	4. for year

Total Solids.

November 1st to April 30th.	
Number samples collected	672
Aggregate	8361.59
Average total	12.46 solids for 6 months
May 1st to October 31st.	
Number samples collected	949
Aggregate	11729.76
Average total	12.36 solids for 6 months
Whole Year Together.	
Number samples collected	1,621
Aggregate	20091.35
Average total	12.39 solids for year

Inspections are made of restaurants, bake shops, butcher shops, confectionery shops, and also of all other places where food is either stored or kept for sale. Under orders of the Board of Health I made a personal inspection of all confectionery and bake shops, most of which were found to be in fairly satisfactory condition.

We have made regulations to govern the sanitary conditions of bake and all other shops where food is kept or offered for sale, and submitted them to the Local Board of Health. They were agreed to.

A number of bakers appeared in the police court and each fined for allowing to be sold bread of light weight. The number of loaves found to be of short weight were confiscated and turned over to Mr. Keane, City Charity Officer, for distribution.

Private slaughter-houses are still in use, and it would be a lot better for everyone, from a humane and sanitary standpoint, if they were abolished. I think the only way in which this can be accomplished is by the establishment of a municipal abattoir, which will ensure a better system of meat inspection for Ottawa. During the year 4,596 lbs. of meat were confiscated as being unfit for food.

In addition to this, there was confiscated a considerable amount of fruit and vegetables, in the way of pears, tomatoes, peaches, grapes, etc., there being in one day 500 or more baskets sent to the incinerator. Throughout the summer we have been somewhat strict and have had the by-law that requires fruit, etc., being covered while outside lived up to. Several were summoned to police court and fined for not paying strict attention to the regulation.

Low Bacteria Count.

I beg to draw the attention of yourself and members of the Board to the quality of the milk supply during this year. We have had an average low bacteria count and a high percentage as regards butter fat—practically 30 per cent. higher than the law calls for. I would also draw your attention to the fact that this average applies for the entire twelve months, and also that the tests made included all the dairies from which the city's supply of milk is drawn.

In conclusion I wish to state that the inspectors under my branch of the department have performed their duties conscientiously and energetically, with the interest of the department at heart.

City Bacteriologist, Joseph Race.

I beg to report upon the work performed in the laboratories for the year ending October 31st, 1913.

During the greater part of the year the work was somewhat restricted on account of the unsuitable laboratory accommodation accessible at the City Hall, but in August the new premises on Slater Street were completed, and since that date the work has been considerably extended. This may not be apparent from the table, showing the total number of samples examined, as the increase is due to the examinations being more complete.

Methods.

For the quantitative determination of the bacterial content the 24 hours' count at blood heat remains unchanged, but the plates incubated at 20° C. are now counted on the third day instead of the second, as was formerly the practise. This gives a result approximating more closely to the actual total bacterial content. Several attempts have been made to introduce the use of gelatine for the enumeration of the bacterial content, as it is generally understood that this media, owing to its differentiation of the liquifying and non-liquifying species, yields more valuable results. The ratio of the liquifying organisms to the total number is so great, however, in the case of the raw river water, as to render accurate counting difficult at all times and often impossible. This does not apply to chlorinated samples and well waters, but it was deemed inadvisable to use different media for different samples, owing to the impossibility of making comparisons between the results obtained.

Neutral Red Bile Salt Agar (Rebipelagar) has also been used for routine work for 10 c.c. quantities of samples, but the results at present are too few in number to warrant deductions being made. The figures for the raw water samples are given in tables. One city sample is plated each day by this method, but not a single red colony has been found on these chlorinated waters since the introduction of this method.

For the estimation of bacillus coli the methods recommended by the American Public Health Association have been followed, but since the completion of the new laboratories the presumptive results so obtained have been confirmed out by first plating out on Litmus-Lactose-Agar, and finally, after growth on sloped agar, transferring to Dextrose Broth, Lactose Broth, Saccharose Broth, and Peptone Water for Indol formation. The results are recorded as typical Bacillus Coli if Dextrose and Lactose are fermented with the production of acid and gas, and Indol is produced in Peptone Water in four days. These biochemical reactions are characteristic of the members of the B. Coli group, which includes B. Coli Communis, B. Coli Communior, B. Aerogenes and B. Acidi Lactici.

For the presumptive test for the B. Coli group, fresh ox bile has been used, as it was found that the concentrated article was not so favorable for the multiplication of the organisms and gas production was consequently delayed.

From the results in Table No. 11 it will be seen that whilst a large majority of the presumptive reactions on the raw river water samples confirmed out, the reverse is the case with the chlorinated samples. A large proportion of the chlorinated samples failed to confirm out on Litmus-Lactose-Agar, for instead of acid colonies being produced the plates were strongly alkaline and gave evidence of ammonia and amine formation. The well water results occupy a position between these two groups, and also show the necessity for extending the B. Coli tests as set forth in the last water report of the American Public Health Association.

Table No. 10 gives the details of the relation of time required for gas formation to the percentage of typical results. It will be seen that organisms in the raw river water producing gas in 24 hours almost invariably prove to be members of the B. Coli group and that the tendency for the chlorinated samples is in the same direction; well waters on the other hand show no definite tendency and every presumptive test should be confirmed out.

These results are very interesting as showing the absolute necessity for confirming out all presumptive tests for B. Coli. Much work is required on each sample but the additional information obtained fully warrants it.

Raw River Water.

The year has been characterized by a drought during the summer months, and this is reflected in the increased color values obtained during the latter months of the year. It might reasonably have been expected that the alkalinity would also show abnormally high results, but the reverse has been found and must be attributed to the drought being sufficiently intense to materially reduce the amount of spring water naturally

flowing into the river. The turbidity was only noticeably excessive during the spring floods in the samples taken from the Ottawa intake, but high results were also recorded on several occasions from samples taken in Lake Deschenes. The bed of this lake is covered with large deposits of silt, which invariably produce a heavy turbidity when a fresh wind is blowing down the lake.

It is impossible to say much regarding the bacteriological condition of the raw water owing to the absence of data for former years with which to compare this year's figures. Speaking generally, however, it is obvious that the tendency is towards a deterioration in the sanitary quality of the water owing to the ever-increasing population on the banks of the river immediately above this city. Reasonable sanitary precautions can prevent access to the river of the sewage of these districts, but the dangers of promiscuous pollution and spring floods always remain. These are the dangers incidental to every surface supply in which the drainage area cannot be controlled.

During the past year the old intake pipe was abandoned as a source of supply and the new pipe again put into commission. This resulted in a more satisfactory supply, but one by no means safe, as the pipe was found to be leaking at several places. Since that time the Water Works Department decided to repair and relay the old pipe, and it is hoped this work will be completed by the end of the year. If this is satisfactory it is the intention of the committee to treat the river section of the new pipe in a similar manner.

During the spring Dr. Houston, of London, examined the present system of chlorination, and recommended that a storage basin be provided at Lemieux Island, in order to prolong the time of contact of the hypochlorite and water before delivery to the city. This work is now practically completed, but the hypochlorite station still remains to be built. The Engineer's Department hope to have this completed as soon as the old intake pipe is in a fit condition to carry the chlorinated supply.

When the whole of this work is finished it is intended to discontinue the addition of hypochlorite at Pier No. 1 and add the major portion of the chlorine at Lemieux Island, the Queen street plant being retained as a precautionary measure. The new plant at Lemieux has been built on the plan of the No. 1 pier installation, except that concrete has been used for the storage tanks in place of wood. It has been my experience that no description of wood, ordinarily available, is suitable for the construction of vessels intended for the storage of hypochlorite solutions. Bronze is also to be used, where practicable, for valves and connections.

Chlorinated City Supply.

During the spring floods and for some time subsequent to those, the tap supply, even after chlorination, showed indications of contamination with excremental organisms, but during the latter months of the year the chlorinated supply, as shown by the bacteriological results, has been of a uniformly satisfactory quality. This is borne out by the number of typhoid cases reported amongst city residents. The total number of deaths occurring in the city during the year was 21, but of these 7 were in November and December, 1912, and were due to last year's epidemic, whilst of the remaining 14, 6 were cases of non-residents. Considering the large number of typhoid carriers that must be living in the city, the aftermath of the two epidemics, I think you will agree that this is a very satisfactory result to have achieved. The chlorination of drinking water however, should only be considered as a temporary expedient or as an adjunct to some other process of purification; it should never be regarded as a permanent measure and especially under the conditions obtaining in Ottawa, where the river water is very unsuitable for this method of sterilization.

Cart Supply.

Early in the spring arrangements were made with the Ottawa Dairy Company for the provision of the water necessary to supply various districts in the City by means of water carts. The water from this well has been regularly examined, and although a slight deterioration was observed during the latter months of the year, the supply has generally been of a satisfactory quality. By regular and frequent sterilization with hypochlorite and steam, the distributing wagons have been kept in the condition necessary for maintaining the purity of the supply and complaints have been rare.

Well Waters.

During the year the Water Works Department have sunk eleven wells in various parts of the city, and the water obtained has been fairly satisfactory in quality. The samples show that although these waters are not of first-class quality, they are gener-

ally above suspicion. Only two wells, viz., Rosemount Avenue and Osgoode Street School, have occasionally given suspicious results, and these have not been sufficiently serious to warrant closing the supplies. Several of these wells have produced water of a peculiar chemical character. Sulphuretted hydrogen was found in nearly all of them, and when the water was first tapped in one well the evolution of this gas was so marked as to render it distinctly inflammable. Notable amounts of sulphides occur in several wells and are associated with carbonates of sodium, calcium, and magnesium, sulphate of sodium, and chloride of sodium. Some of these salts have a distinct pharmacological action, and if the waters were more concentrated they would be of medicinal value.

MILK.

The milk samples have been increased in number during the year and bacteriological routine examinations are now made on each supply. As there are three classes of milk submitted for examination and only a serial number is supplied, it is impossible to make any statement regarding this important branch of the work. The results are forwarded to the Chief Food Inspector, in whose report a synopsis will doubtless be found.

TABLE 1.

Raw Water—Ottawa Intake.

	AGAR Bacteria per c. cm.		Colonies per 10 c. cm. on Rebipelagar	Percentage of samples showing B. Coli in				Temperature Degrees F	Turbidity parts per million	Colour	Alkalinity parts per million
	3 days at 20° C.	1 day at 37° C.		50 cc	10 cc	1 cc	0. 1 cc				
OLD INTAKE											
November, 1912	132	24	....	100	95	18	0	38	8	67	29
NEW INTAKE											
December	138	12	....	100	92	42	0	36	6	73	32
January, 1913.	127	12	....	100	100	84	23	33	4	75	32
February	71	7	....	100	100	29	4	32	5	75	31
March	11,279	69	21.0	100	100	50	29	35	74*	58	30
April	9,741	34	2.0	100	100	69	15	39	39	46	34
May	123	16	0.9	100	100	69	0	52	12	50	26
June	168	34	3.2	100	100	62	0	62	11	56	19
July	188	48	3.2	100	100	44	12	71	9	63	20
August	198	133	2.0	100	100	44	4	69	8	70	20
September	73	14	7.7	100	96	25	0	56	9	76	20
October	82	17	9.3	100	92	22	4	58	9	81	20

TABLE 2.

Raw Water—Hull Tap Supply.

	AGAR Bacteria per c. cm.		Colonies per 10 c. cm. on Rebipelagar.	Percentage of samples showing B. Coli in			
	3 days at 20° C.	1 day at 37° C.		50 c.c,	10 c.c.	1 c.c.	0.1 c.c.
November, 1912	....	....	....	....	....	....	....
December	....	....	....	....	....	....	....
January, 1913	....	....	....	....	....	....	....
February	43	7	....	100	100	23	0
March	14,068	54	28.0	100	100	62	5
April	12,297	26	1.6	100	100	83	6
May	241	16	0.9	100	100	74	0
June	120	12	3.4	100	99	50	8
July	117	34	4.2	100	99	44	4
August	84	28	2.9	100	100	48	9
September	63	18	14.4	100	100	16	0
October	94	43	14.7	100	94	44	11

TABLE 3.

CHLORINATED WATER.

(Samples taken from Queen Street Pumping Station.)

Month.	Bacteria per c. cm. AGAR.		Percentage of samples showing Bacillus Coli in			
	3 days at 20°C.	1 day at 37°C.	50 c.c.	10 c.c.	1 c.c.	0.1 c.c.
November, 1912	14	6	88	15	0	0
December	8	4	72	16	0	0
January, 1913	10	6	65	19	0	0
February	6	3	71	12	0	0
March	28	17	92	33	0	0
April	33	16	92	37	0	0
May	6	3	80	23	0	0
June	12	3	78	4	0	0
July	9	3	52	12	0	0
August	20	3	64	12	0	0
September	6	2	54	0	0	0
October	4	2	46	0	0	0

TABLE 4.

CHLORINATED WATER.

(Samples taken from Wellington Ward.)

Month.	Bacteria per c. cm. AGAR.		Percentage of samples showing Bacillus Coli in			
	3 days at 20°C.	1 day at 37°C.	50 c.c.	10 c.c.	1 c.c.	0.1 c.c.
November, 1912	10	6	88	16	0	0
December	9	5	88	24	0	0
January, 1913	8	4	68	20	0	0
February	4	3	79	4	0	0
March	23	10	82	22	0	0
April	27	14	92	50	0	0
May	5	4	81	11	0	0
June	64	10	66	21	0	0
July	16	4	60	16	0	0
August	13	3	80	12	0	0
September	5	4	50	0	0	0
October	4	2	38	0	0	0

TABLE 5.

CHLORINATED WATER.

(Samples taken from Dalhousie Ward.)

Month.	Bacteria per c. cm. AGAR.		Percentage of samples showing Bacillus Coli in			
	3 days at 20°C.	1 day at 37°C.	50 c. c.	10 c.c.	1 c.c.	0.1 c.c.
November, 1912	....	....	....	....	....	....
December	10	4	92	33	0	0
January, 1913	7	4	53	18	0	0
February	8	5	85	9	0	0
March	20	8	73	13	0	0
April	51	22	92	38	0	0
May	5	3	52	5	0	0
June	29	4	87	29	0	0
July	22	3	52	12	0	0
August	9	3	96	8	0	0
September	14	3	66	8	0	0
October	12	2	54	0	0	0

TABLE 6.

CHLORINATED WATER.

(Samples taken from Central Ward.)

Month.	Bacteria per c. cm. AGAR.		Percentage of samples showing Bacillus Coli in			
	3 days at 20°C.	1 day at 37°C.	50 c.c.	10 c.c.	1 c.c.	0.1 c.c.
November, 1912	9	6	84	19	0	0
December	6	4	96	16	0	0
January, 1913	6	3	65	15	0	0
February	5	3	84	12	0	0
March	23	15	89	33	4	0
April	23	13	96	42	0	0
May	7	3	65	0	0	0
June	36	5	87	21	0	0
July	15	4	56	12	0	0
August	14	5	96	28	0	0
September	41	5	96	4	0	0
October	16	2	60	0	0	0

TABLE 7.

CHLORINATED WATER.

(Samples taken from Capital Ward.)

Month.	Bacteria per c. cm. AGAR.		Percentage of samples showing B. Coli in			
	3 days at 20°C.	1 day at 37°C.	50 c.c.	10 c.c.	1 c.c	0.1 c.c.
November, 1912	11	4	100	37	0	0
December	10	4	83	8	0	0
January, 1913	11	3	75	18	0	0
February	8	7	80	10	0	0
March	21	10	66	23	0	0
April	50	15	88	24	0	0
May	27	5	91	39	0	0
June	56	5	86	57	0	0
July	23	10	56	18	0	0
August	34	14	100	5	0	0
September	32	12	100	62	0	0
October	11	4	60	20	0	0

TABLE 8.

CHLORINATED WATER.

(Samples taken from the Hintonburg Supply.)

Month.	Bacteria per c. cm. AGAR.		Percentage of samples showing B. Coli in			
	3 days at 20°C.	1 day at 37°C.	50 c.c.	10 c.c.	1 c.c.	0.1 c.c.
November, 1912	12	6	81	34	0	0
December	8	5	80	20	0	0
January, 1913	7	4	57	11	0	0
February	5	3	46	8	0	0
March	21	14	75	12	0	0
April	21	13	54	19	0	0
May	6	3	50	4	0	0
June	7	4	42	4	0	0
July	9	5	20	0	0	0
August	4	2	56	2	0	0
September	4	2	37	0	0	0
October	3	2	11	0	0	0

TABLE 9.

TIME OF GAS FORMATION IN PRESUMPTIVE BACILLUS COLI TESTS.

—	September.			October.		
	Raw river samples.	Chlorinated river samples.	Well samples.	Raw river samples.	Chlorinated river samples.	Well samples.
Percentage of tests showing gas in 24 hours	48	29	21	45	11	84
Negative 24 hours but positive 48 hours	52	71	79	55	89	16

RELATION OF TIME OF GAS FORMATION TO TYPICAL BACILLUS COLI.

—	Percentage of Confirmatory Results to Presumptive Tests.					
	September.			October.		
	Raw river samples.	Chlorinated river samples.	Well . samples	Raw river samples.	Chlorinated river samples.	Well samples.
Gas formation in 24 hours	100	75	67	95	50	32
Negative 24 hours but positive 48 hours	60	18	44	44	7	68

TABLE 10.

CONFIRMATORY RESULTS OF PRESUMPTIVE TESTS FOR BACILLUS COLI.

—	Raw river samples.	Chlorinated river samples.	Well samples.	Month, 1913.
Percentage of presumptive tests positive on Litmus-Lactose Agar	82	51	71	
Percentage of presumptive tests showing Typical B. Coli	78	33	35	September
Percentage of Typical B. Coli capable of fermenting Saccharose	72	88	81	
Percentage of presumptive tests positive on Lactose-Litmus Agar	75	47	79	
Percentage of presumptive tests showing Typical B. Coli	71	10	52	October
Percentage of Typical B Coli capable of fermenting Saccharose	74	100	87	

TABLE 11.

HYPOCHLORITE TREATMENT DETAILS.

—	Main Supply.			Hintonburg Supply,		
	Water pumped in millions of galls. per day	Hypochlorite added in lbs. per million gallons.	Available chlorine parts per million,	Water pumped in millions of galls. per day.	Hypochlorite added in lbs, per million gallons.	Available chlorine parts per million.
November, 1912	17.8	99	3.3	0.63	87	2.9
December	17.7	89	3.0	0.65	87	2.9
January, 1913	17.4	76	2.5	0.60	95	3.2
February	18.2	78	2.6	0.70	83	2.8
March	18.1	77	2.5	0.65	94	3.1
April	18.0	74	2.5	0.60	110	3.7
May	17.9	62	2.1	0.56	118	3.9
June	18.0	54	1.8	0.59	112	3.7
July	19.0	52	1.7	0.64	103	3.4
August	19.7	51	1.7	0.71	94	3.1
September	19.4	62	2.1	0.62	106	3.5
October,	18.2	60	2.0	0.68	97	3.2

SUPERINTENDENT OF MILK STATIONS, GRACE E. MOORE, R.N.

I have the honor to present to you the report of the Infant Milk Depots for the year ending October 31st, 1913.

The work which began at the Ottawa Dairy, June, 1910, under the supervision of Dr. W. T. Shirreff has grown steadily and this summer we operated four depots, viz.:—

No. 1—207 Church Street.
No. 2—7 Irving Avenue.
No. 3—298 Division Street.
No. 4—138 Queen Street (West).

Two depots, Nos. 1 and 3, were open all winter, 1912-13. On May, 1913, No. 2 was re-opened with Miss Stewart in charge, and No. 4, a new depot, was started with Miss Davidson as nurse in charge.

June 8th, 1913.—No. 1, at 368 Patrick Street, was partially destroyed by fire, the caretaker and his family barely escaping with their lives, but thanks to the excellent work of Chief Graham and his firemen the milk and office furniture were saved, and we dispensed milk as usual the same day.

June 13th, 1913.—207 Church Street, a vacant shop, was secured and there we carried on the summer work until October 6th, when the depot was moved to 288 St. Patrick Street, as it was thought better to be on a main street and the rent was considerably less.

Clinics are held once a week at each depot, with the exception of No. 3, where two are found necessary, the doctors giving their time and services gratuitously.

All milk used at the depots is certified from the Ottawa Dairy and we charge our people the price of ordinary milk—8c. in the summer and 9c. in the winter months. Those too poor to pay are given a card which, when signed by Mr. John Keane, enables the bearer to obtain free milk.

Each depot is becoming more and more a school for the mother instead of merely a depot to sell milk, as most of the milk that comes to the city is good and we encourage the mothers to nurse their babies and drink the milk themselves. Since starting our work the number of breast-fed babies has increased remarkably. When it is necessary to give the baby a bottle home modifications are taught and the nurses show the mothers how to prepare each day's nourishment.

On October 1st, 1913, Depot No. 2 was closed, and Miss Stewart was transferred to the depot at 298 Division Street.

From May 20th, 1912-October 1st, 1913, a Victorian Order Nurse has been with us, doing excellent work. However, it was found better to have Board of Health Nurses during the winter, and ask the Victorian Order to help us if necessary with the summer work.

The hours at the depots are from 9 a.m.-12 noon, when the milk is dispensed and advice given by the nurse in charge. From 1 p.m.-5 p.m. the homes are visited and instructions in general regular care taught. On Sunday the nurses are on call.

I would recommend that next summer we have six depots, the new ones to be one in Mechanicsville and the other in Ottawa East, and of course the one in Hintonburg at the Y.W.C.A. reopened.

I wish to thank Drs. Shirreff, Brunet, Beroard and Tilly, also my nurses and assistant for their earnest co-operation and very efficient help during the year.

The following statistical table and financial report will be of interest:—

No. Depot.	No. of treatments of babies at depot.	No. of visits of babies at depots.	No. of visits of babies at home.	No. quarts milk dispensed.	No. Deaths.
1..........	898	1,890	1,765	16,631	6
2..........	223	274	537	2,989	4
3..........	669	1,013	1,696	10,663	9
4..........	82	318	595	1,415	0
Total..	1,872	3,495	4,593	31,698	19

Cash to City Hall		$1,460 98
Daily milk sold	$1,427 41	
Extra milk sold	12 02	
Barley flour sold at 10c. lb.	13 00	
Baby bottles sold, 5c. each	8 55	
Total	$1,460 98	$1,460 98

REPORT OF THE DISINFECTOR.

Ottawa, December 15th, 1913.

DR. T. A. LOMER,
Medical Officer of Health,
City Hall, Ottawa.

Dear Sir:—

I beg to submit my annual report for the year from November 1st, 1912, to October 31st, 1913. The number of houses disinfected by me were as follows:—

Respectfully submitted,

(Sgd.) R. J. SMITH,
Disinfector.

Months.	Diphtheria	Scarlet Fever.	Smallpox.	Measles.	Typhoid Fever.	Tuberculosis.	Schools.	Houses as a precaution.	Number per month.
November, 1912	41	6	3	4	1	5	5	4	69
December	45	6	11	6	2	13	12	9	104
January, 1913	47	40	16	21	2	8	11	12	157
February	26	14	16	179	9	10	6	10	270
March	33	18	8	428	11	12	8	13	522
April	29	16	10	282	7	19	6	8	377
May	44	21	11	170	1	14	6	12	279
June	15	14	3	38	5	11	4	18	108
July	21	21	6	6	8	7	0	16	85
August	16	21	2	1	22	4	0	12	78
September	26	14	2	1	24	8	3	5	83
October	35	30	2	9	26	2	9	6	119
Totals	378	221	90	1145	109	113	70	125	2,251 Total for the year.

BIRTHS—OTTAWA

November, 1912—October, 1913

	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Total
	78	71	68	55	79	71	90	73	65	82	68	57	857

DEATHS—OTTAWA

November, 1912—October, 1913

Causes	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Total
General	9	26	27	13	11	15	28	6	17	10	17	15	196
Chol. Inf.	2	5	1	1	2	1	1	1	21	30	7	3	75
Accident	7	3	4	3	4	3	4	6	8	2	7	8	59
Still B.	2	5	7	2	4	1	4	6	....	1	4	7	41
Tuberculosis	....	....	2	1	2	2	....	2	3	3	2	2	19
Typhoid	....	1	1	....	....	....	....	....	....	....	1	2	* 5
Whooping Cough	....	1	....	....	1	1	....	....	....	....	....	....	3
Scarlet Fever	....	....	....	....	....	....	1	....	....	....	....	....	1
													399

* This does not include 8 deaths from patients outside of city.

INFECTIOUS DISEASES—OTTAWA

November, 1912—October, 1913

Diseases	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Total
Tuberculosis:													
Cases	....	....	2	....	....	....	1	....	2	2	5	....	12
Deaths	....	....	2	1	2	2	....	2	3	3	2	2	19
Measles:													
Cases	....	2	4	37	23	12	3	11	17	1	2	2	114
Deaths	....	....	....	....	....	....	....	....	....	....	....	....	0
Scarlet Fever:													
Cases	1	4	3	3	3	16	8	....	3	1	3	1	45
Deaths	....	....	....	....	....	....	1	....	....	....	....	....	1
Typhoid:													
Cases	3	9	1	2	....	1	....	....	2	17	26	19	80
Deaths	....	1	1	....	....	....	....	....	....	....	2	1	5
Whooping Cough:													
Cases	....	....	1	....	....	....	....	....	....	....	....	....	1
Deaths	....	1	....	....	1	1	....	....	....	....	....	....	3
Chickenpox:													
Cases	2	3	1	5	3	1	1	2	1	....	....	....	19
Deaths	....	....	....	....	....	....	....	....	....	....	....	....	0
Diphtheria:													
Cases	3	1	1	1	1	3	....	4	....	....	2	3	19
Deaths	....	1	....	1	....	....	....	....	....	....	....	....	2
Smallpox:													
Cases	1	....	....	....	....	6	....	4	....	....	2	3	11
Deaths	....	....	....	....	....	....	....	....	....	....	....	....	0
Mumps:													
Cases	....	....	....	1	10	16	26	4	2	....	....	1	60
Deaths	....	....	....	....	....	....	....	....	....	....	....	....	0
													391

PETERBOROUGH.

DR. A. W. MCPHERSON, M.O.H.

I beg to present to you a report of the work done during the year 1913.

It gives me pleasure to say that there has been more practical progress made this year than in any of the three preceding years that I have been in charge of the health department. This is due in part to the efficient health act we now have, in part to the active support of the members of the Board, and not a little to the good work of our Sanitary Inspector.

During the eleven months past we have been blessed by a freedom from any serious epidemic, and in fact we have been very free from serious disease of any kind. It is interesting to note that, according to the Registrar General's report for 1912, Peterborough has the lowest death rate of any city in Ontario. That must be a source of very great gratification to you who are interested with the health of the citizens and should give you confidence to continue in the same aggressive manner in order that you maintain the same high standard.

During the year we suffered from an epidemic of measles that began about the beginning of the new year, reached its height in April and terminated about the middle of May. In all about 126 places were placarded, including the Barnardo Home, the Children's Shelter and the St. Vincent's Orphanage. Quite a percentage of those attacked were adults. The disease was of a rather severe type, although only two deaths were reported. Both cases were complicated. Owing to the fact that quarantine was enforced, we found it advisable to use the diphtheria side of the hospital for measles. Altogether we accommodated 44 patients.

Next in order comes typhoid with 18 cases reported in. In all probability there were more as often times the case is not reported at all. Many times the physician is in doubt until the disease progresses. By the time that he is convinced that his patient is suffering from typhoid he has forgotten or he neglects to report it. Thus it makes it difficult to follow up the case and determine the source of infection and if we do learn the source we are several weeks late in warning those who may be in danger from the same cause. Of the 18 cases reported in, five had been visiting or living out of town just previous to being taken ill, seven were using well water, one was a nurse who had been waiting on a typhoid patient, the remaining five were using city water in their homes. In one of these cases boiled water was used exclusively. Where there are so many ills and so many houses without sanitary conveniences, it is surprising that there is not more sickness of this nature.

Scarlet fever comes next in order with fifteen cases, eleven of whom were treated in the hospital. It is interesting to note that in only one house was there a second case, and that occurred before the first one was taken away.

Diphtheria was reported from six families and in one family two children were affected. Four of these were treated in the hospital.

The following is a list of the cases reported in:

	No. of cases reported.	No. of Deaths.
Measles	126	2
Typhoid	18	0
Scarlet Fever	15	1
Diphtheria	7	0
Tuberculosis	7	30
Smallpox	1	0

We have purchased three maps of the city, one for typhoid, one for tuberculosis and one for scarlet and diphtheria. As the cases are reported in, the locality is marked with a pin.

The sanitary work in the city has progressed very much during the year and we are planning for a further development next year. Before the warm weather began we had the attention of the public drawn, through the columns of the daily press, to the section of the Health Act relating to cleaning up the premises. This was followed by a thorough systematic inspection of as much of the city as time permitted. In this tour, the inspector examines the premises inside and outside. The following are the important points that are noted: The number of occupants, the amount of accommodation, the fitness as a dwelling house, the facilities for disposal of sewage and kitchen refuse, the sickness during the year, the water supply, the animals kept, the cleanliness of the house and the premises generally. These are tabulated systematically in a book which we had made for the purpose. Where the conditions are unsatisfactory, these are pointed out and if necessary a notice is left giving them a reasonable time to clean up. This is followed up and if our request is not acceded to a complaint is laid before the magistrate. I am glad to say that during the year there were only 15 police court cases.

We are of the opinion that our work is to a great extent educational. Sometimes it is the tenant, sometimes it is the landlord that requires the training. But in spite of our efforts, there is a great deal to be done if we are going to have our citizens living under the conditions most conducive to health. We still have a great many outside privies that are contaminating the wells and the atmosphere, providing a first-class breeding-place for flies and often making it uncomfortable, sometimes almost unbearable for the neighbors in the hot, oppressive summer evenings. The compulsory sewer-connection by-law will make it much easier to remedy this unsanitary condition where there are sewers and city water on the street. But where these conveniences are not present, suggestions are made as to changes that will minimize the danger and discomfort.

The matter of keeping cows, pigs, chickens and other animals on the premises gives rise to conditions that call forth complaints from the neighbors. The larger the city becomes, the more this complaint must be listened to and action taken to provide a remedy. There is nothing definite in the act with regard to the keeping of any animals except pigs. In respect to the others, the clause referring to conditions which are unsanitary or detrimental to health is the one that forms the basis for any action we may take. There is no doubt that the unsanitary conditions that are associated with the keeping of these animals are responsible for a certain amount of sickness. The wells often become infected through the source being contaminated or from surface water draining in or from infectious material which is deposited in the covering of the well and which is washed in through the cracks.

There are a large number of dwellings that are far from what they should be in a city of this size. Sometimes the building is not worth repairing or the amount of rent does not warrant any expenditures. Sometimes an old building is divided into two or the upper floors in the business blocks are turned into flats without a thought of the comfort and health of those who are to occupy them. The result is that we often find a bedroom or a bathroom and closet without any provision for light or ventilation except from another room. Premises without a water supply or without sanitary conveniences separate from their neighbors are frequently found. In one case a landlord has the front part of a house divided into two parts to be let to different parties, while the kitchen (a small one at that) is used in common. Many other conditions of a similar nature could be brought to your notice that are not conducive to the welfare of the poor people. We are trying to improve matters as far as we are able. There are many difficulties in the way as you gentlemen know; perhaps the greatest is the need of houses suitable for the working class that will be cheap enough and still situated near enough to the different factories.

The hotels, restaurants, boarding houses, baker shops, butcher shops, fruit stores, slaughter houses, laundries and dairy farms have been systematically inspected. A number of written reports of the conditions found have been presented to you during the year and the work that we are trying to do has met with your approval. In all cases we are insisting on general cleanliness of the premises and of the employees, proper sanitary conveniences, properly situated, and a freedom from flies as far as possible.

During the year several health by-laws were passed by the Council on the recommendation of the Board, and others were resurrected. The compulsory sewer connection by-law will make it easier to secure proper sanitary conveniences in places where nuisances exist. The by-law prohibiting the dry sweeping of the sidewalks is another important piece of legislation and will help to promote the comfort and health of the citizens. We attempted to enforce the regulations with regard to the exposure of food products but found that our jurisdiction in this respect did not extend within the street line. If such is the case we hope to secure the desired results in another way. Spitting on the sidewalks and in public places is a dirty, dangerous habit. The fight against tuberculosis has brought this more forcibly to our minds and it was decided to enforce the by-law prohibiting it. With this in view as well as to educate the people generally of the dangers metal signs are to be purchased with an appropriate caution. These will be distributed around the city.

Further indications of progress are shown in the extension of the garbage system, the building of an incinerator, the installation of sanitary drinking fountains in the schools and on the street and the application of the gross dirt test to the milk.

Before closing, I would like to make a few recommendations for your consideration:

1. That an assistant be secured for the Sanitary Inspector.

2. That the plumbing inspector be placed under the control and direction of the health department.

3. That the area in which garbage is collected be extended.

4. That the scavengers or night-soil men be licensed and work under the control of the Sanitary Inspector.

5. That the following licenses be issued by the health department:

Milk vendors.

Boarding and rooming houses.

Scavengers.

Dog.

6. That the health department disinfect at the expense of the department all premises where infection has occurred or where it is thought necessary.

7. That the Board of Health recommend to the city council that they consider at any early date the necessity of having a municipal abattoir.

9. That the health department publish a short bulletin in the daily papers once a month.

10. That milk be delivered to private houses only in bottles.

11. That a smallpox hospital be built.

PORT ARTHUR.

Dr. C. N. Laurie, M.O.H.

I have the honor to present my report for the year 1913.

On account of the large number of houses being built in our city, extending for miles from our sewerage and water systems, the work of your Medical Health Department is daily becoming more and more difficult. To try to keep a city of this size sanitary and clean, especially with so many foreigners of the poorer class in our population, requires constant attention and watchfulness.

There has been a vast improvement this year since the city has an organized scavenger department making regular calls to remove the garbage. Our inspectors have done good work and have summoned a number of persons before the magistrate, when after repeated warnings, they refused to clean their yards. Also a number for neglecting to have the proper sewer connections made. The majority were punished by a fine which had a good effect on themselves and their neighbors. One source of constant trouble has been the swamp, better known as the coal dock section. This has been especially dangerous, having been flooded this year by unusually heavy storms.

The opening of wider sewers has had a beneficial effect, still that section shall always be a menace until a proper system of sewers be put in and the streets and properties raised to a higher level.

We had twenty-four deaths from typhoid, eleven of whom came from outside the city limits. Seventeen of the deaths were among foreigners. I am pleased to be able to say that we have only had one case reported during the last month.

The water supply has given your officials a great deal of worry during the year on account of the new breakwater throwing the current directly on our intake pipe. The engineer has watched very carefully the chlorination plant at the power house, which has done good work, especially since we had the advice of the provincial laboratory which was here for a few weeks last summer. I feel that the time has now arrived on account of the great growth of our city, when we should establish a city laboratory of our own. I expect the province may open a laboratory for the district, but it would hardly be able to give us the attention we require, on account of the large amount of work it would have to do.

We have treated in our isolation hospital during the year seven cases of scarlet fever, seven of mumps, four chickenpox, three smallpox, seven erysipelas and three diphtheria, with one death, a child from diphtheria.

I found during my visits to the schools that a large number of the pupils were suffering from eye, nose, ear and throat troubles. On receiving my report, your council made arrangements with specialists whereby those children might receive the necessary treatment, and I am pleased to state that 38 have received treatment to date. This good work, which reflects the greatest credit to your council, will be continued until every child needing it may have the benefit of proper treatment.

On looking over the death certificates for the year, I found that out of 106 deaths among children, 48 were stillborn and 16 of premature birth, which means that 64 children died at birth or within a few hours of birth. I consider this a startling proportion and worthy of official investigation.

I also notice that there have been 14 deaths from tuberculosis with only three cases reported. This, I believe, arises from the fact that we have no provision for treating these cases. Also because a great many people finding they have the disease consider it hopeless and do not employ a physician. The time has arrived when this city must provide proper hospital accommodation for these cases, which might be arranged in connection with the present hospitals. I have had a large number of indigent cases during the year, chiefly from the police station and the cheap boarding houses.

We have been able to solve the water problem at the isolation hospital by boring a well through the rock, fortunately finding good water at a depth of 96 feet. We have ordered a pump and motor to pump the water to the tank at the top of the building, thus, we hope, settling forever this important question.

The inspectors have kept close watch on the hotels, restaurants, butcher shops, barber shops, cold storage and dairies, the sanitary inspector taking samples of milk from the wagons for testing. I do not think that we have found the best way of watching the milk by getting samples occasionally as the inspector can catch the wagons. I think that all milk sold in the city should first pass inspection at a central milk depot, and any person selling milk from a can without the depot stamp on it should have his license cancelled. It would not be necessary to test all the milk brought in every day, but the fact that the milk had to go to the depot would have a good effect on dishonest dealers.

PORT ARTHUR.

T. F. Milne, Secretary.

In accordance with Sec. 23, sub-section 2 of "The Act respecting Public Health" passed in 1912, I beg to present my annual report, covering the year 1913 to the end of November.

The board was re-organized at the first of the year, and is now composed of five members as required by statute. The membership is as follows: J. A. Oliver, Mayor ex-officio; A. G. Seaman, J. T. Emmerson, Geo. Benger, and Dr. C. N. Laurie.

The latter was appointed at a salary of $3,000 and among his duties have been included a weekly visit of the schools and free attendance on all indigent cases. It is also a condition of his appointment that all private practice be given up.

The first meeting was held on January 31, at which Mr. A. G. Seaman was appointed chairman. Though the statutes require only four meetings in a year, the Board decided to meet at 2.30 in the afternoon the first Tuesday in every month. Up to date nine meetings have been held. There were no meetings in June or August on account of lack of a quorum.

I will now endeavor to give some account of work performed by the Board during the year and some account also of works performed in other departments connected with health, but not coming immediately under your supervision:

1. Early in the year, we called the attention of the council by resolution, to the necessity of wrapping bread and asked that a by-law be passed making this compulsory. The matter was discussed by the council at different times, but up to the present nothing has been done. It was felt that, as the bakeries here are small and not equipped with machinery for the above purpose, a by-law would work hardship and probably raise the price of the loaf.

2. In 1911, the city secured special legislation in response to your request to enable them to install sanitary conveniences on premises where you insisted such work should be done. The Act giving the city this power, places the work in the same class as local improvements. The engineer is to see that the work is done, the work is to be especially assessed, and the payments spread over a period of five years and collected yearly with the other taxes.

We have a by-law before the council at the present time to raise $12,600 to cover the cost of installations made in the year 1912. I have no figures as to the amount expended in 1913, as the assessment has not yet been made. At the present time, the medical officer of health and the plumbing inspector have instructions to prepare a further list of properties for submission to the council.

3. This year, the council passed and published a new By-Law, No. 977, to regulate the scavenging of the city. It was felt that for the first year this would be partly an experiment. This by-law has now been "tried out," its weakness discovered, and the engineering department is now getting out a revised by-law, which will be submitted to the Provincial Board of Health for their approval. In former years, the council held what was called a "Clean Up Day." Notices were published in the papers, calling on all the citizens to have their garbage placed in barrels or boxes, and the engineer's department would remove same on a stated day. Interest was stimulated by offering bonuses to boys for gathering loose cans, wire, paper, etc. Collections made otherwise than for clean-up day were paid for on a regular schedule. The receipts shown on the scavenging account in the treasurer's books are mostly deferred payments, and next year your board will need to bear in mind that these payments will be very small. Under the new by-law the engineering department took charge of the scavenging, laid out the city in routes, and advertised the day of the week on which each of these routes would be served. Householders were urged to purchase a can, "The Hercules," at a

cost not to exceed $3.25. It was felt that the use of this can would help in the campaign for keeping down flies. The total expenditure on this service has been to the end of October $8,637.05 and the account shows credits of $4,047.63, leaving a net cost of $4,589.42.

You will note what I say above about the credits.

4. Early in the year, you called the attention of the council to the necessity of having a specialist treat school pupils who were suffering from diseases of the eyes, ears, throat and nose. A committee was appointed, of which Ald. Burriss was chairman, and reported on July 25th ninety children suffering from eye trouble, 48 from nose and throat and 22 from ear troubles. By resolution 514, the council adopted the report of the committee, by which arrangements were made with Drs. Hunt and McCullough to treat these cases at $5.00 per patient. The medical officer of health was to administer the anaesthetic, if such should be necessary. It was estimated that the parents of one-third of the cases would be able to pay. The hospitals were to provide a dark room and free treatments were to be administered at the two hospitals, one day each week. The medical officer of health was instructed to keep an accurate report of cases treated and the amount of money received. We have had no further report, and the treasurer informs me that he has neither received or paid any money on this account.

5. In August and September, we were threatened with an outbreak of typhoid. Several of these cases were from outside points, and for a number of the local cases, the cause was felt to be in the immediate surroundings. As a general precaution, instructions were given to use a larger amount of Hypo-Chlorite and a letter published in the papers instructing the citizens as to precautions to be taken. Conditions are now much improved.

6. During the year we had reported up to the end of November 109 cases of contagious diseases and 49 deaths from same. These were divided as follows:

	Cases.	Deaths.
Smallpox	1	0
Scarlet Fever	9	0
Diphtheria	6	2
Measles	8	1
Whooping Cough	0	3
Typhoid Fever	78	24
Tuberculosis	3	14
Infantile Paralysis	0	0
Cerebro-Spinal Meningitis	3	2
Tubercular Meningitis	0	3
Erysipelas	1	0
	109	49

Of the above deaths from typhoid, 11 are from outside points and 13 from the city.

7. I present you a table, showing the births and deaths, with the total deaths from all causes during the last five years and the percentage that the deaths of children under one year bears to the total number of deaths from all causes.

Births	1 yr.	2 yr.	3 yr.	4 yr.	5 yr.	Total deaths from all causes for years
1909 ....346..	101	9	3	5	3	204
1910 ....414..	96	16	1	1	0	255
1911 ....469..	78	15	4	0	1	224
1912 ....499..	83	22	1	1	2	270
1913 ....649..	109	27	2	4	0	310
Total....2,377	467	89	11	11	6	1,263

	Deaths	under 1 year	equal	35.5%	of total	deaths for	the five years.	
In 1909—	"	"	"	49.5%	"	"	from all	causes.
1910—	"	"	"	37.6%	"	"	"	"
1911—	"	"	"	34.8%	"	"	"	"
1912—	"	"	"	30.7%	"	"	"	"
1913—	"	"	"	35.2%	"	"	"	"

8. In February your board passed a resolution asking that an additional amount of land be granted the isolation hospital, so that a scheme could be worked out for the cottage treatment of different classes of contagious diseases, so that the city might be freed from the danger of claims on account of cross infections. The council has not seen fit to grant your request, but they have had four acres surveyed out and a map of this property, with a copy of the engineer's letter, is now placed before you.

During the year, up to the end of October, this hospital has cost:

Maintenance	$2,823.05
Interest and Sinking Fund	434.33
Insurance	21.00
Capital account (Well and Ice House)	528.37
	$3,806.75

There are no credits on this account.

As the city waterworks does not extend to any point near the hospital your board have found it necessary to drill a well. The work on this has been completed and is now ready for installing a pump.

The pump and requisite motor are now on order, and we are advised that they will be here soon.

9. The treasurer's books show an expenditure of $4,879.50 in his "Public Health Account." This includes a portion of the salary of the medical officer of health, and the sanitary and plumbing inspectors.

10. The engineering department have been very busy this year on work in connection with a new intake and an attempt to solve the question of sewage disposal in the city. In consultation with T. Aird Murray, several conferences have been held with the provincial health authorities, and up to the present nothing definite has been arranged. In the meantime, the council has been considerably criticized for the condition of the low-lying land south of John Street. Until some definite understanding is reached in regard to the sewage disposal plant, the council can promise the residents in this low-lying district no relief, except such as can be obtained by surface drainage. The council and the engineer are alert to their responsibilities, but until the Provincial Board of Health has suggested some plan satisfactory to our council, or has approved plans worked out by Engineer Jones and Mr. Murray, things must stand as they are.

Owing to delays in commencing the work, receiving material, etc., and unforeseen conditions, the new waterworks intake cannot, in all probability, be used as a source of supply until about July, 1914. In the meantime we are still using the old intake and great care and attention is being given to the proper treating of the water with Hypo-Chlorite. On November 12th an unfortunate accident occurred when a boat entering the dry dock and dragging anchor caught the intake pipe and lifted it to the surface. Repairs were immediately commenced, but are not yet completed. Immediately the accident occurred, notices were published in the two daily papers, for one week, to have consumers boil the water used from the taps, and an additional amount of Hypo-Chlorite was used. There has been expended on these works this year up to the end of October, the following amounts:

New System	$234,855.42	
Extension, water mains	29,368.52	
		$264,223.94
Sewers		33,362.10
Expended on Waterworks and Sewers		$297,586.04

A summary of the above items of cost, omitting the sanitary installations, is as follows:

Waterworks and Sewers	$297,586.04
Public Health	4,879.50
Isolation Hospital	3,806.75
Scavenging	4,589.42
	$310,861.71

ST. CATHARINES.

DR. F. KING, M.O.H.

I beg to submit the following report on the sanitary and other conditions relating to public health for the year ending October 31st, 1913.

Generally speaking the health of the city has been fairly satisfactory.

As the Secretary of the Board will present a full and interesting report on vital statistics, and on the sanitary work done during the year, it will not be necessary to refer to those items in detail.

Of communicable diseases there were reported the following:—

Scarlet Fever	18
Diphtheria	11
Whooping Cough	3
Measles	42
Chicken-pox	3
Erysipelas	2
Typhoid Fever	36
Tuberculosis	11

Apart from tuberculosis, these classes of disease were accountable for three deaths.

It will be remembered that toward the end of August, and early September, a short-lived epidemic of typhoid fever prevailed; 32 cases were reported. All were immediately investigated and recorded, with the result that 16 were patients brought into the city for treatment from boats passing through the Welland Canal, or from other municipalities; 12 of the remaining cases were traced to the use of water other than that of the city system, and local conditions were responsible for the remainder.

The milk supply was free from contamination, and not responsible for this epidemic.

Of the 21 deaths due to tuberculosis 13 were reported from the sanatorium, of these nine were sent to that institution from the city, and four from other municipalities.

Too much praise cannot be given to the Consumptive Sanatorium for the good work carried on under the able management of the energetic superintendent. This institution furnishes a comfortable home for many advanced cases of "The White Plague" who, without its aid, would be a menace and a greater expense to the city.

SANITATION.

A very large amount of sanitary work has been done during the past nine months, a detailed statement of which the Secretary will present in his annual report, but I may say in passing that there were over 1,000 inspections, notices given, fumigations, etc., made by the Sanitary Inspector since January last, as well as upwards of 200 made by myself as the Medical Officer of Health.

The sanitary conditions are improving, and the people generally are becoming wise to the desirability of removing or improving unsanitary places. There remains, however, much to be desired, particularly in connection with tenement and rooming houses and other premises.

The garbage dump has caused a few complaints, but for some months it has been kept in as fair a sanitary condition as it is possible to keep such places. Pending the establishment of an incinerator, this or some other location more or less objectionable must be used.

MILK.

During the year a Milk By-law, in conformity with the Ontario Milk Act, 1911, was adopted by the council, and a milk inspector authorized. Samples have been regularly sent to the provincial laboratories at Toronto for analysis and other samples regularly tested by the Inspector here for butter fat, temperature, specific gravity, and dirt or sediment. Of 103 samples sent to Toronto, four recorded below 3 per cent. of butter fat. Of 113 samples tested locally the result was nearly as satisfactory. It must be remembered, however, that these tests cover only three or four days in each month.

The dirt testing instrument has been most useful in finding sediment, and demonstrating to the vendor the careless handling of his product. It was found that one vendor frequently used formaldehyde as a preservative; the renewal of this vendor's license should be a question for the earnest consideration of this Board. With a few

exceptions the milk now supplied is satisfactory as regards the quality and cleanliness of this important article of food. There has been, however, an always increasing shortage in the supply, but I have reasons to believe that this will be overcome in the near future.

Water.

During the past ten months samples of the city water have been sent to Toronto each week for analysis, 111 samples in all. The reports show that 17 samples were contaminated with bacteria of intestinal origin. Of nine samples taken from wells and natural springs in adjoining municipalities, all but two showed contamination. The water supply of the city will require serious consideration in the immediate future, and should not be delayed until an epidemic occurs.

The ideal supply would be by a pipe line direct from Lake Erie, taken from a point west of Port Colborne, failing this, and if the supply is to be continued from the Welland Canal the danger will increase yearly, owing to the works now commencing, to the possible presence of typhoid carriers, to the increasing boat traffic through the channel and to the fact that the canal is to use a part of the Welland River in the new construction with its miles of unsanitary waters. The only safety would appear to be in adopting a suitable filtration system and a chlorinating appliance, preferably by chlorine gas.

Recommendations.

I beg to recommend:—

1. Establish an area to include all streets provided with sewer accommodation within which area outside closets will be prohibited, and in this connection adopt and carry out the following section of the Public Health Act: Section 25, Subsection 2:

"Where a local board in any city recommends that sanitary conveniences shall be installed in any building, and is of the opinion that the owner of the premises is unable to pay the expense of the same *at once*, the municipality may install suitable sanitary conveniences at the expense of the owner, and the board may direct that the cost, including interest at 5 per cent., be paid by the owner in equal annual payments, extending over five years."

2. Extend the garbage system and provide by by-law that householders shall wrap all house waste in paper before placing the same in proper covered metal receptacles, and enforce the use of the covered metal receptacle.

3. Adopt and provide for daily testing of the milk supply.

4. Complete and equip the Isolation Hospital and provide trained assistance and nursing.

The question of street sweeping and sprinkling, meat inspection, plumbing inspection, and garbage removal should also receive the earnest consideration of this Board and of the City Council.

All of which is respectfully submitted,

ST. THOMAS.

Dr. D. A. McKillop, M.O.H.

I submit the following brief report of the health of this city for the year ending December 31st, 1913.

With the exception of two small outbreaks of smallpox and quite a number of cases of typhoid, some occurring during every month in the year, as enumerated below, the city has been in a very healthy condition. The following cases of communicable diseases have been reported to me during the year:—

Scarlet Fever	13 cases.
Diphtheria	8 cases.
Smallpox	12 cases.
Typhoid	56 cases.

Of the thirteen cases of scarlet fever and eight cases of diphtheria, the majority were the result of cases coming from other points outside our municipality.

Nine of the twelve smallpox cases were directly traceable to an epidemic in another municipality. The origin of the remaining three cases could not be clearly traced.

The city being a railroad centre is the cause of the large number of typhoid cases.

Four large main lines of railroads pass through our city and the large proportion of typhoid cases were trainmen, as engineers, firemen, or brakemen.

Quite a number of the cases were the result of infection from nursing or contact cases.

A few were the result of drinking water from wells in the city. The cases taken by months were as follows:—

January	3 cases.
February	1 case.
March	2 cases.
April	3 cases.
May	4 cases.
June	4 cases.
July	1 case.
August	8 cases.
September	7 cases.
October	7 cases.
November	7 cases.
December	9 cases.
Total	56 cases.

During this year, two hospitals, one for scarlet fever and one for diphtheria, have been erected on a beautiful site at the south-western part of the city. A small-pox hospital is also under construction in the rear portion of the same site. With these three new cottage hospitals, finely equipped and beautiful in appearance, erected on an isolated part commanding one of the most lovely sights of the city, we are in a much better position to treat our communicable diseases than in the old shacks where they were formerly treated.

Inspections of meat and provisions have been made regularly during the year by our Inspector, Mr. W. J. Shaw.

Milk inspections were made both quantitative and qualitative by our City Analyst, A. F. McLachlin, who also keeps a strict watch on our water supplies, with the result that for years not one case of sickness has been traced to that source.

We have had the pleasure of several visits during the year from our District Medical Officer of Health, Dr. Bentley, of Sarnia, from whose visits we have derived great profit.

During the year, accompanied by members of the Board of Health, Inspector Shaw, and myself, Dr. Bentley visited and inspected our schools, collegiate institute, hospitals, water works, slaughter houses, and some private dwellings which were under condemnatory proceedings.

We hope Dr. Bentley will visit us often, as we appreciate his efforts in aiding us to maintain a clean and healthful city.

SAULT STE. MARIE.

A. S. McCaig, M.O.H.

As required by the Public Health Act, we beg to submit our report of the sanitary conditions of the city during 1913 and a short account of the work accomplished by the Board of Health during the year.

Vital Statistics to Date.

Births	271
Deaths	256
Marriages	151

INFECTIOUS DISEASES.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.	Deaths.
Diphtheria	13	2	5	9	2	5	1	2	0	0	1	0	40	3
Smallpox						1	5						6	
Scarlet Fever						2							2	
Measles						2							2	
Typhoid Fever							1	29	31	7	17	0	85	12
Tuberculosis														15

1. *Diphtheria.*—Of the diphtheria cases 36 were from the city, 2 from Steelton, 1 from Sudbury, and 1 from Spragge. The advantage of the Isolation Hospital in the cleaning up of this disease is apparent. The steady fall in the incidence of the disease, from month to month, shows the advantage of complete isolation of the cases. Last year there were 97 cases of the disease and nine deaths therefrom.

2. *Smallpox.*—There were six cases of this disease. Four cases occurred in one family. Complete isolation of the cases, vaccination and rigid quarantine of all those exposed to the disease prevented any secondary cases.

3. *Tuberculosis.*—This disease still maintains its lead in the death column. There were 15 registrations of death from tuberculosis during the year. Several of these were of Indians from Garden River and the Shingwauk Home. I think the educational campaign for the instruction of the public as to the prevention of tuberculosis is beginning to show results. Children as well as adults are becoming educated as to the cause of the disease and the means for its prevention and cure. An afternoon was recently devoted to lectures to the school children by the physicians of the city, who kindly attended the different schools of the city for the purpose of addressing the children and parents. Last month Dr. G. D. Porter, Secretary of the Canadian Association for the Prevention of Tuberculosis, delivered a lecture on "Tuberculosis as a National Problem," and Dr. R. E. Wodehouse, Provincial District Medical Officer of Health, also delivered an address on matter pertaining to the public health.

4. *Typhoid Fever.*—During the year there have been treated in the city 105 cases of this disease, as follows:

From Sault Ste. Marie	85 cases.
From Steelton	13 cases.
Boats, Camps and other Municipalities	17 cases.

The epidemic began early in August. The public were warned to protect themselves by boiling or chlorinating the water. These precautions were not generally observed and cases of the disease continued to occur rapidly until the middle of September, by which time the chlorination of the water began was adopted and the disease began at once to abate.

A study of the figures will at once show the benefits of chlorination. During August and September the disease occurred at the rate of one case per day. In October there were only seven cases of the disease, and of these five, or over 70 per cent., were in workmen at the steel plant, where non-chlorinated water was being used or was available for drinking purposes. In November there were 17 cases, of these two were secondary house infections and 10 or 66 2-3 per cent. of the primary infections were in workmen at the steel plant, where non-chlorinated water was available for drinking purposes. If anyone has ever had any doubt as to the advantages of chlorination in making a *safe*, if not at all times a pleasant water, we hope these figures will help to dispel their doubts.

The question of the water supply is an important one for your honorable body at the present time, and for the citizens for a long time to come. Regardless of cost, if the matter can be financed at all, we are in favor of a Gros Cap intake. Not getting this, we will, for the present time at least, have to be satisfied with the water from the least contaminated source in the St. Mary River, with a filtration plant to remove 90 per cent. of the impurities and a minimum dosage of chlorine for further purification. We do not see the advantage of spending $75,000 or more going out to the head of the Rapids, where the water has been shown to be contaminated, if the water has to be filtered and chlorinated from whatever source it is taken in the river. The best plan seems to be to make our present source safe and go to Gros Cap as soon as possible. The boats are the most dangerous source of contamination as far as typhoid fever, dysentery and other diarrhœal diseases are concerned. Of the 17 outside cases six were taken off boats, so you can judge of the danger of contamination from this source.

There were twelve deaths from typhoid fever this year. The deaths in the majority of cases were of young adults between twenty and thirty years of age. This terrible loss of life is preventable. During the recent visit of the Hon. W. J. Hanna to this city he remarked while discussing the typhoid epidemic here, and the conditions causing it, that "every death from typhoid fever should and might soon be a proper subject for investigation by a coroner's jury."

Dairies and Milk Supply.

During the year the large dairymen and the milk dealer with only one cow were compelled by the Board to have their milk cows tested for tuberculosis. In all 37 dairymen had their cows tested, over 300 cows being examined. The results were surprising. One herd had 11 diseased animals in it, some of them young heifers that would soon be supplying milk to the public. In the largest dairy, comprising nearly 100 cows, there was one tuberculous cow. Mixing this cow's milk with the milk from the rest of the herd would contaminate the whole supply from that dairy. Every quart of milk sold by that dairy was a source for the spread of tuberculosis. Other dairies had one or two affected cows. The sale of milk from affected cows was stopped and animals either isolated from the rest of the herd or slaughtered.

Our efforts this year have been largely directed to improving the general sanitary conditions throughout the city. Nothing approaching the work done this year has been accomplished before. The Board of Health made life miserable for the man with the dirty back yard and filthy outhouse. The number of sewers installed on the different streets by order of the Medical Officer of Health and Sanitary Inspector was 177.

The collection of the garbage by the Sanitary Committee was well looked after, considering that the system was newly inaugurated this year. The plan will work well when every house is compelled to keep a proper garbage can. The only way to prevent disease is to have a clean city and a pure water and clean milk supply. The systematic collection will keep the city clean and do away with breeding places for flies, which are the greatest carriers of disease.

STRATFORD.

Dr. J. A. Robertson, M.O.H.

In presenting my annual report regarding the health of the city for the past year, am pleased to state that on the whole it has been up to its usual standard, apart from an epidemic of measles at the beginning of the year, there has been no special cause for alarm, all the contagious diseases having been less than in the previous year. It is a pleasure to state that out of the cases reported, and there were many others who did not report, there were only two deaths.

While in sympathy with the regulations of the Provincial Board of Health regarding placarding of houses in which measles exist, and realizing the importance and necessity of endeavoring to control the spread of such diseases on account of the serious sequelæ occuring in connection therewith, yet, I feel it is a hardship for those who comply with the regulations to be shut up until the time of quarantine has elapsed, while those feeling "it was only measles" and made no report thereof were permitted to go free. In my opinion an epidemic of this nature cannot be controlled until it has exhausted itself.

Since presenting last report the Public Health Act of Ontario has been revised and many important new features introduced. By the revised act the Province is divided into seven districts, a trained medical officer supervising the sanitary work in the district allotted to him. There is also a reduction in the number of members of local boards in a city, and in every town having a population of four thousand or over the Board shall consist of three resident tax-payers instead of five as heretofore, they being appointed annually by the council at its first meeting in every year. The Mayor and the Medical Officer of Health are members of the Board, the latter being its executive officer. Prior to the revised Ontario Act the tenure of office of the Medical Officer of Health was at the discretion of the Council. Now this official cannot be dismissed except for cause and with the consent of the Provincial Board of Health. The benefit of this is obvious—power is given to a municipality to regulate and inspect its meat supply. There is an annual conference of Health Officers, the municipality is required to make provision for payment of the expenses of the Medical Officer of Health for attendance at such conference, such meetings are of untold importance to the general public, sanitation in every phase being discussed thereat and every means which might trend to prevent disease

receives consideration and discussion, and important suggestions to that end are brought out. The Council is required to make provision for the medical and surgical attendance of indigents, am pleased to note that it has complied with the spirit of the Act in that respect.

Regarding the reporting of communicative diseases, the period given is shortened to twelve hours instead of twenty-four as heretofore.

For the information of the profession and the public I would like to call their attention to section 72 of The Public Health Act dealing with the period of quarantine required after exposure to infection in the case of infectious diseases and the earliest date of return to school after attack. The period of quarantine required after last exposure to infection in the case of measles is sixteen days, scarlet fever ten days, diphtheria twelve days, chicken-pox fourteen days, mumps eighteen days. The earliest date of return to school after attack according to section 72 as stated is in the case of measles three weeks, scarlet fever six weeks, diphtheria three weeks, chickenpox and smallpox when all scabs have fallen off. Whooping cough six weeks after the commencement of the whooping, mumps four weeks if all swelling has subsided. The above refers to more communicable diseases. I would like to call the attention of the profession to the fact that they have been delinquent in reporting cases of typhoid fever or suspected cases. The Act requires them to report such cases within twelve hours after suspicion or diagnosis of same. The Provincial Board of Health is determined that delinquents in the matter of reporting this disease shall be brought to justice.

This has seemingly been overlooked by the profession, as few cases of typhoid have summarily been reported. Tuberculosis is also a reportable disease. Regulations require whenever any legally qualified medical practitioner knows that any person who he is called upon to visit is infected with tuberculosis he shall within twelve hours give notice thereof to the Medical Officer of Health of the Municipality in which such diseased person is. This is not for the purpose of quarantine, but that the Secretary of the Provincial Board of Health, who becomes notified of the case, may mail to the address of the patient such instructions for the care and the prevention of the disease as may from time to time be authorized by the provincial board. Under the regulations the Medical Officer of Health has power to commit a tuberculosis patient in a hospital or sanitarium under certain conditions. All information furnished to the Medical Officer of Health or local Board of Health and the entries made by the Medical Officer of Health and all subsequent reports furnished with respect to any cases or suspected cases of tuberculosis shall, so far as possible, be treated confidentially, and all persons having official knowledge of the case shall not divulge or permit to be divulged any of the particulars to any person except as authorized by the regulations."

During the last year two cases of small-pox were reported. These were dealt with without any extra expense to the city, the Medical Officer of Health and the Sanitary Inspector supervising and taking charge of the same. Dealing with this, I would like to call the attention of the Board to the fact that, according to the "Vaccination Act" recently passed, the Council of every city shall contract with one or more legally qualified medical practitioners for the period of one year, and so from year to year as the contract expires, for the vaccination at the expense of the corporation of all poor persons resident in such municipality, who come to such medical practitioner for that purpose. The Act explicitly states that if the corporation neglects to make such contract and such neglect continues for one month after the attention of the Council has been called, as is now being done, the local Board may contract with the Medical Officer of Health or other legally qualified medical practitioner, to perform all the duties which may be performed by, or are incumbent upon a medical practitioner under this act. The father and mother of every child born in the city, shall at some appointed time, within three months after the birth of such child, or in the event of the death, illness, absence or inability of the father and mother, then the person who has the care, nurture or custody of the child, shall at some appointed time within four months after the birth of the child, take or cause to be taken, the child to the medical practitioner in attendance at the appointed place, according to the provisions of the preceding sections for the purpose of being vaccinated. If the father or mother or person having the care, nurture or custody of the child does not cause the child to be vaccinated within the period prescribed by this Act the parties so offending shall incur a penalty not exceeding Five Dollars. Every prosecution under this Act shall take place before a police magistrate or two justices of the peace, and "The Ontario Summary Convictions Act" shall apply thereto.

I would like to call your attention to the fact that very little seems to have been done towards having a system of garbage collection and disposal introduced. Your Board urged upon the Council over two years ago to have some system promptly carried out, but so far nothing tangible is brought forth.

Our city is now rapidly being built up and residences are therefore becoming in

closer proximity, so that the danger to the health of the citizens arising from accumulated garbage and rubbish becomes greater as the city grows. Your officers are frequently asked why we had not had this important matter attended to.

During the year there were one hundred and twenty-two deaths from various causes reported in the city, of these thirty-two lived over the allotted time, seventy years. Of the acute and preventable diseases pneumonia claimed the greater number of cases, fourteen having died from the disease during the year.

Of the usual preventable diseases, scarlet fever, measles, whooping cough, and diphtheria, we have reason for congratulation that no deaths were reported as occurring from the first three mentioned. Diphtheria 5 deaths, scarlet fever 3 deaths, tuberculosis 5 deaths.

The report of Thomas Dunseith, Sanitary Inspector, is included herewith.

THOMAS DUNSEITH, SANITARY INSPECTOR.

In presenting my report for this year, I will endeavour to show you some of the more important work I have done during the year. Owing to the vigilance of the M.O.H. and myself I consider that great improvement has been made in the better sanitation of the city.

I notified the keepers of the livery stables and feed stables to provide closely covered receptacles for storing manure, and these bins to be emptied once a week or oftener according to the number of horses kept on the premises. All private citizens who keep horses have not complied with the request of the Board, but many of them have done so, and we expect that ere another year passes all will see the necessity of complying with this request of the Board of Health.

I inspected nearly all the back yards and outside closets in the city. Found in many cases that the closets were in very filthy condition, but owing to the faithful work of Messrs. Montgomery and Connelly (scavengers) we have made greater progress in the removal and disposal of night-soil than in previous years. I sent notices to all parties in Fire Limits A and B to abolish all outside closets according to by-law, but in some cases the law has not been complied with. Some people are not in a position, financially, to stand the cost of the improvements. Others have houses that are old and without cellars where it would be troublesome to keep out the frost, but in many cases the necessary changes have been made.

I sent out notices to the junk men to discontinue the carrying on of their business in their present locations. Also notified the Clerk and Mr. Lawrence to withhold their licenses until they found suitable places to do business in. They have complied with the terms of the by-law.

Have inspected the laundries frequently and found them in fair condition. I have also inspected the restaurants many times during the summer, found them well kept and clean with one or two exceptions, and these have made the necessary improvements.

The butcher shops are kept in fair condition. Gave them notices to have screens on doors and windows.

I inspected the slaughter houses several times during the year. Found some of them as well kept and clean as that kind of killing place can well be, in others there was great need of improvement.

The Medical Officer of Health, the Chairman, his Worship, the Mayor, and myself made inspection of the dairy barns, and found most of them in splendid condition, a credit to their owners. To a few we were obliged to make suggestions of improvements with which they have complied, and all have received their licenses except those who belong to the Stratford Dairy Co. They claim that they have a charter from the Government to do business in the city, and so have no right to pay for a license as individuals.

I took samples of milk at various times during the summer and tested it, and also made one general test of all the milk sold by the milk vendors in our city. It was all up to the standard. The result of the general test was published in the city newspapers.

I tested water from wells all over the city. Usually found the water unfit for use. Would advise people to get in the city water wherever possible.

I have had numerous complaints about the odors arising from Erie Creek. The stench from it on Church and Birmingham Streets and the Collegiate Flats is very offensive all summer and also perilous to the public health. I would respectfully request the City Council to have the creek covered, as at present it is nothing but an open sewer.

In the beginning of the year we had an epidemic of measles. Had 185 houses under quarantine for that disease alone. We had 27 cases of diphtheria with two deaths. Eleven cases were sent to the Isolation Hospital. Of scarlet fever, we had 14 cases. Of infantile paralysis, there were three cases. There were seven cases of consumption. Five cases of typhoid fever were reported in September. We had two cases of smallpox, and, as in all cases of infectious disease, the greatest care was exercised to prevent the spread of the disease. We isolated these two cases in their own house, and had all the children who had been in contact with them vaccinated, and one family who had frequented the house for a few days previous to the outbreak we quarantined also. Owing to these precautions, the disease was confined to the two cases. I disinfected in all 240 houses.

WOODSTOCK.

Dr. F. S. Ruttan, M.O.H.

I herewith submit the Annual Report of the Health Department for the year ending November 15th, 1913.

There were 139 deaths (exclusive of still births and a suicide) which gives us a mortality rate of 13.6 per thousand.

REPORTABLE DISEASES FOR 1913.

Diseases.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Total.
Chickenpox	2	....	....	....	....	....	9	1	....	....	....	....	....	12
Scarlet Fever	....	2	....	6	13	21	11	4	....	....	....	....	....	57
German Measles	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Typhoid Fever	....	....	1	....	....	....	....	....	....	3	5	2	....	11
Measles	....	....	....	....	1	....	1	6	....	2	....	....	....	10
Diphtheria	....	....	....	....	....	....	1	....	....	....	1	....	....	2
Whooping Cough	....	....	....	....	....	....	....	....	2	....	1	6	4	13
Erysipelas	....	....	....	....	....	....	....	....	1	....	....	2	....	3
	2	2	2	6	14	21	22	11	3	5	7	10	4	109

There is still a laxity in the reporting of communicable diseases, whooping cough, particularly, being neglected.

Eleven cases of typhoid fever were reported during the year, five of which were non-resident; the remaining six cases were undoubtedly contracted outside the Corporation.

Sanitation.

Satisfactory progress has been made to further sanitary conditions. Two rear lanes have been drained and paved; a number of sewers have been constructed, and a garbage system inaugurated for systematic collection.

In instituting a garbage collecting system many difficulties have been encountered, and am sorry to report the laity in general are not co-operating in this move and giving the support which it merits.

It is the duty of every citizen to limit their garbage to the minimum and keep it in properly covered receptacles, of convenient size that the same may be quickly handled, thereby lessening the cost of collecting—as much time is lost by not observing the garbage by-laws. It is only a matter of a comparatively short time before we shall have to consider the establishing of an incinerator for the destruction of waste material.

In a paper read at the Canadian Public Health Association by Mr. Antonisen, C.E., he claims "that a properly constructed garbage incinerator can be operated at a reasonable cost and frequently a revenue derived."

I cannot do better than to quote part of his address: "My attention has lately been called to a water-heating garbage burner which is manufactured in Kewanee, Ill., and can be installed in ordinary private houses for from $150 to $250. It is claimed for this apparatus that it will destroy all house garbage and develop sufficient heat to provide

hot water for domestic purposes. The Municipal Engineer should investigate such matters and advocate their introduction in hotels, boarding-houses, large private and public institutions, hospitals and asylums."

Our scavengers report over 1,300 outside closets, a number far in excess of what should be with the present population. I strongly recommend the abolishing of outside closets where sewers are convenient; by doing this, much would be gained in the interests of sanitation.

More attention must be given to our sewage system, and allowance made for future development.

During the year five houses have been closed as unfit for habitation. This part of the sanitary work has been sadly neglected, and little can be accomplished until some move is made to relieve the present scarcity of dwellings.

Owing to the advent of natural gas, provision should be made whereby we can be assured of an efficient inspection of gas fixtures.

The request for the appointment of a Sanitary Inspector has not met with approval of your honorable body. I can assure you there is sufficient work to keep a sanitary inspector busy continuously.

I would direct your attention to the need of a public lavatory—also the placing of hygienic drinking fountains at the various public stations.

Milk Supply.

Dairies were inspected by our Veterinary Inspector, and later in the season by Dr. Bentley, District Officer of Health, together with several members of your local board. We found that the various dairies had been marked at too high a rating.

The By-law asking for a public monthly report for butter fat has outlived its usefulness and is a great injustice to some of the vendors.

I would suggest that this by-law be rescinded and that your local board be entrusted to obtain a pure milk supply, which can only be obtained by efficient inspection and the application of scientific tests.

Public Abattoir.

General conditions, as revealed by inspection of local slaughter-houses, should be sufficient incentive for some progressive move to secure inspection of all meat, before and at the time of slaughter. Am confident if Woodstock aldermen were to make this inspection they would not be content until better conditions prevailed for the production of their meat supply.

Isolation Hospital.

The isolation building (for smallpox) has been used at irregular intervals as a clubhouse by some undesirable element.

The present quarters are ideal for this sort of thing, and I beg leave to suggest a more desirable location.

An isolation hospital for infectious diseases other than smallpox would be a blessing in disguise. It would also furnish an opportunity for our local nurses to secure practical knowledge of nursing communicable diseases.

Plumbing.

I would again direct your attention to this phase of sanitary work. Much plumbing has been installed during the year, and who is to say that the work has been efficiently done?

In conclusion, I wish to thank the individual members of the Board for their hearty co-operation in dealing with public health questions.

GALT.

Dr. T. W. Vardon, M.O.H.

In making my annual report for the past year, I am pleased to say that we have reason to be thankful that we have not had any serious outbreak of any contagious or infectious disease.

You will see by the annexed report from our Divisional Registrar that in all we have had 22 cases of scarlet fever with one death, eight cases of typhoid fever with

three deaths. Three of these came from out of town to our hospital for treatment, where two of them died, leaving only one death from that disease chargeable to our town. We have had no deaths from diphtheria or smallpox.

The total number of deaths from all causes is 167. Deducting the stillborn and those who died in our hospital who were residents of outside places, make our death-rate twelve per thousand. There were 282 births, about twenty-four per thousand, being double the death-rate, which is satisfactory.

The Swiss Cottage has been opened for 142 days, and eighteen patients were treated therein during that period, and, I am pleased to say, all of whom were discharged cured. In this connection I would recommend that the building be wired so that we may be able to use the Hydro-Electric for light and for cooking during the summer months.

Our town is spreading out in all directions, and both the waterworks and sewers will have to be extended to meet this growth and give the new factories and householders these necessary conveniences.

We can also be thankful that during the past year we have made some progress towards bettering the sanitary condition of our town. The collection of garbage is now being carried out by the contractor in a satisfactory way, considering the time that the by-law has been in force. The collection and disposal of garbage in all municipalities is a vexed problem and one that is giving the health boards a great deal of trouble and can only be carried out successfully by the co-operation of householders and others giving their assistance to those who have charge of the removal of the same and the health boards in assisting to make the garbage by-law work out for the benefit of all as smoothly as possible.

The Council has wisely passed a " Milk By-law." This by-law is now in operation, having been approved by the Minister of Agriculture. It provides that all those who sell milk in the municipality must first take out a license. It also provides that before said licenses are granted that the cow stables, water supplies, utensils, etc., that are used in the handling of milk must be inspected and approved of by the Medical Officer of Health, and that the milk must contain not less than a certain amount of butter fats and solids. That the vendors of milk and those supplying milk to the vendors must not only keep the buildings in which the cows are kept but everything used in connection with the handling of milk in a sanitary condition. Hereafter all milk sold in our town must be delivered in bottles at a temperature not above 50 deg. fahrenheit. In very hot weather this is often difficult to do, and I would advise the users of milk to pasteurize the same during the hot months of the summer before using.

I am pleased to say that our butchers are now installing proper slaughter-houses that are built under the direction and supervision of the health boards, which will insure to the users of meat that the same is handled and prepared under proper sanitary precautions.

During the summer we had a visit in his official capacity of Dr. McNally of Guelph, District Officer of Health for this division. Together with him we inspected the slaughter-houses, restaurants, and candy factories, also the schools, waterworks and hospital. Our public buildings are in good shape and those in charge deserve the thanks of our citizens for looking after them and keeping them in first-class condition.

I am thankful to the medical men for promptly reporting contagious diseases, for this is a great help in curtailing the spread of any infectious disease and also assists in tracing the cause.

NORTH BAY.

Dr. E. Brandon, M.O.H.

I beg leave to submit to you my first annual report as Medical Officer of Health of this municipality. This is the first full year that the new Public Health Act has had full course, and operation and results of its wisdom are very evident and manifest in our town. The appointment under the act of the District Medical Officer of Health tends to keep all ends caught up and all sections of the act enforced. The appointment of a permanent Sanitary Inspector and Plumbing Inspector was insisted upon by the district officer, and has resulted in an efficient, zealous officer, who has done a great deal of hard work and—the result—greatly improved sanitary conditions in town.

During the year, up to December 15th, the number of communicable diseases reported to me have numbered as follows:—

Diphtheria	28	4 deaths.
Scarlet Fever	22	1 death.
Measles	4	
Chicken-pox	1	
Smallpox	1	
Tuberculosis	2	
Typhoid Fever	1	
Total	59	

The number of communicable diseases has been very low, so far as we can ascertain with few deaths, as the deaths are not reported to the Health Officer as required by the Public Health Act. I find the members of the profession zealous in reporting all cases of communicable diseases and anxious to take all means of prevention against spreading. Nevertheless, many cases of measles, mumps, tuberculosis, etc., etc., are not reported as required by the Act, and it is just as incumbent upon the householder to report such cases in his house as it is upon the attending physician, and any householders harboring such cases and treating them in a domestic way are liable to prosecution for non-compliance. The death-rate in the province from measles has gone up to such an extent that the disease is placed upon the placard list and quarantine insisted upon, because heretofore the public have regarded the disease too lightly, not calling in a physician, have allowed their children to return to school early and communicate the disease to others, very often with disastrous results.

Water.—The water from Trout Lake has been in a very satisfactory state both from bacteriological examination made from time to time and clinically, as no cases of typhoid could be traced to impure water in our mains. Analysis of three samples by Dr. Amyot of water taken during the month of August, when one would expect infection or pollution most, disclosed a "low bacteria count and no gross pollution," so that the water supply at Trout Lake has been very satisfactory. Yet care and watchfulness are necessary to prevent pollution, especially when there are a large number of families situated along the shores and where the drainage naturally gravitates to the lake.

Sewers.—Early in the year the Sanitary Inspector and myself made a trip over the town and in a report to the Council recommended that certain sewers be constructed to remedy many urgent conditions throughout the town. Citizens were suffering from insanitary conditions which needed sewers as a remedy. So far as our observation goes these recommendations, with very few exceptions, were sent to the limbo of the waste paper basket, so far as actual results are concerned. Sewers are urgently needed all over the town, but especially in the foreign quarters, as it is almost impossible to secure sanitary results without them. In our opinion a sanitary survey of the town is a necessity. The need of a large trunk sewer becomes more apparent year by year and in our opinion should not be put off much longer. The ridge of rock running from Second Avenue to Third Street shuts off a large section from sewers on account of the difference in levels to the present system, and a trunk sewer at a low enough level situated possibly on First Avenue would allow of laterals to these sections of the town as well as others. We find the present storm sewer system emptying into Chippewa Creek at Regina Street being used as a sanitary sewer, which is absolutely unlawful. Crude sewerage is being emptied into the creek without any attempt at disposal and is a menace to the community. As a partial solution to that situation we suggested to the Council, subject to engineering feasibility and the approval of the District Medical Officers, that this sewer be converted into a combined system sewer and a septic tank be constructed at Regina Street to dispose of this sewage. A large section of the town would have been supplied with sewers if this could be carried out. So that in our view a sanitary survey of the town should be undertaken and a consulting municipal engineer employed to recommend to the town the best solution of our needs in that line. The town should do away with the present system of employing an engineer at irregular disconnected intervals, as the method tends to lack of continuity in service and inefficiency. Were the engineer employed on a permanent yearly basis for entire time and service the Commissioner would have at his disposal at all times a man capable of giving him the technical information and data so necessary to the solution of all the municipal engineering problems confronting him daily.

Garbage and Night Soil.—The establishment of a garbage collection system has materially helped in improving sanitation. This collection is only applied to part of the town, some 90 places being served, but we believe that it should be made to cover the entire town and should be provided for out of the ordinary tax. In some municipalities the town is paying some of this expense by consuming the garbage, so suited,

in a municipal piggery, and so lessening or materially reducing the cost of operation. I believe the city of Chatham has gone into this system, simply because they saw it demonstrated by private parties as a paying proposition. This system might be looked into further and investigated for the town's benefit.

There are some 900 closets being used in town from which night-soil has to be removed periodically. The Council made a move in the right direction in adopting a standard or type of closet for future use. The design is, so far as possible, fly-proof, which is an immense advantage. The prohibiting of pit-closets is extremely wise, as they are a great menace to the public health. The present can-system, while possessing many advantages in time of handling and cleaning, has perhaps greater disadvantages because of small capacity, freezing in winter, and the tendency on the part of some users to drive a nail into them and let out liquid excreta. Possibly if our system of cleaning were more perfect we should not have so many complaints. We are of the opinion that the larger water-tight drawer-box style is equally as good, if not better, though not perhaps as easily cleaned. The by-law should be altered to permit of their use as optional with the present can system.

Dumping Ground.—The present dumping-ground has been put in much better shape. On taking office this year it was in a deplorably insanitary state, as no attempt had been made to handle the immense amount of dead animal, vegetable and other decaying matter. To make things worse hogs were travelling over it and feasting on the offal and garbage. This has all been promptly remedied. The Sanitary Inspector commenced a thorough clean-up and instituted some system and order in the matter of dumping in future. A constant smouldering fire is now maintained to destroy everything brought there. The distance from town, however, and the bad roads militate against best results. A shorter route would enable us to cope with the matter more readily. By the installing of a large incinerator nearer to town would overcome the difficulty and more effectively dispose of the garbage and night-soil. One of these incinerators is now in operation in the town of Haileybury and is giving entire satisfaction I believe. The collection of night-soil should be undertaken as part of the municipal garbage collection system and should be charged up to the houses so served, just the same as a special tax, *e.g.*, after the manner of a dog tax. The information as to the number and location is now at hand by reason of the census taken by the Sanitary Inspector. Yearly this information may be obtained from the assessment slips if so ordered by Council.

Milk Inspection.—The new by-law going into force January, 1914, will put into our hands an effective weapon to deal with this problem of supplying good, clean, wholesome milk to the citizens. Heretofore, we have had no complete knowledge as to who are the vendors, producers or carriers. From the new year on we shall be able to cope with this problem. During the year frequent analyses of milk for butter fat and for dirt have been made, and some have been found wanting in fat and too full of dirt, etc. The Health Department should be provided with a room in the City Hall where analysis of milk, etc., can be carried out and provided and equipped more fully with instruments for such tests and examinations. Also the necessary fyles for recording their tests and other information expedient to the Health Department work.

As a member of the local Board of Health I may voice their sentiments when I say that the Council has treated our recommendations better and paid the bills sent in with less quibbling and distrust than previous councils, in my experience. The Board often have very difficult situations to handle, and to have the Council firmly at our back and not quibbling, materially helps. Nevertheless, we are of the opinion that the Board should be allowed, as it is by law, to make its appropriations yearly, and if some of the work were handed over directly to it, greater efficiency would result, and a lessening of the Council's work would ensue. In other words, it should be regarded in its work as separate, the same as any School Board in the town. We are satisfied all would result to the town's advantage. During the year able assistance was rendered by Dr. George, the district officer, and Mr. Geo. Young, provincial inspector for this district. Both these gentlemen were very ready and willing to extend to us the benefit of their experience and knowledge in sanitary matters. An exhibit of moving pictures and a lecture given on December 8th by the Provincial Board was well attended, and the lecture and explanations by Dr. George were of great educational value.

ORANGEVILLE.

Dr. T. H. Henry, M.O.H.

During the present year there have been reported the following number of contagious diseases:—

Diphtheria	3 cases.
Measles	1 case.
Chicken-pox	none.
Scarlet Fever	none.
Tuberculosis	1 case.
Smallpox	7 cases (one family).

One case of diphtheria was contracted in Montreal, the patient dying shortly after arrival at Orangeville.

One or two cases of measles were visitors, who contracted the disease inside of the town.

The cases of smallpox, as far as we can learn, were contracted by members of the afflicted family coming in contact with a Mrs. Tiffin and daughter, who were allowed out of quarantine at a relation's place in Collingwood.

This latter place was quarantined as chickenpox, which apparently was a mistake, as evidence the serious outbreak of the disease in Collingwood shortly afterwards.

Proper and prompt action were taken in all these cases, and the result of these strict precautions was no further outbreak or spread of these diseases.

You are aware of the visit of Dr. McNally, District M. H. O., and the inspection of fruit stores, bake shops, slaughter-houses and sanitary conditions generally.

The conditions found were very bad indeed and contrary to the Public Health Act.

Drastic changes and remedies were suggested and ordered. There was some attempt made in improvement of the first two, but still decided need of a greater endeavor: as to the latter nothing as yet has been attempted. The same conditions exist, which are a menace to the public health.

It is necessary and would advise some attempt should be made in the near future to remedy the sewage conditions as they exist at present by installing or building a proper sewerage system and sewage disposal.

APPENDIX B

THE DISTRICT OFFICERS OF HEALTH, PROVINCE OF ONTARIO

BY DR. JOHN W. S. MCCULLOUGH, CHIEF OFFICER.

This is a special report upon the work of the District Officers of Health for the period from the 1st of December, 1912, until the end of the year 1913.

The Provincial Board of Health was established in the year 1882 when the first Public Health Act of the Province was enacted. The Board with its Secretary were for many years the sole public health workers in the Province. Epidemics of smallpox and of various communicable diseases, the sanitary conditions of the Province, the water supplies, sewage works and the care of lumber camp employees were controlled and supervised with the aid of occasionally employed medical students and young medical practitioners through the indefatigable energies of Dr. Peter H. Bryce. In the year 1899 Dr. Charles A. Hodgetts, who since 1890 had been in the service of the Board, was appointed Provincial Medical Inspector, and when Dr. Bryce resigned in 1904 to enter the immigration service at Ottawa, he was succeeded by Dr. Hodgetts, and Dr. R. W. Bell was appointed Provincial Inspector. During these later years several extensive outbreaks of smallpox in the newer portions of the province, typhoid fever in Fort William, Cobalt and other places left these officers with but little leisure. In 1906 Mr. Geo. E. Young was appointed Sanitary Inspector for the Province and upon him devolved much of the duty of looking after the hundreds of lumber, mining and railway construction camps in North-Western Ontario. These officers performed their duties in a fearless and most zealous manner and a great deal of credit is due them and to the members of the various Provincial Boards of Health with whom they worked.

Since the laboratory of the Provincial Board was first established, under Professor J. J. Mackenzie, valuable services have been provided the medical practitioners of the Province and the public generally, in relation to the diagnosis of typhoid fever, diphtheria, tuberculosis, and in the examination of water supplies. Professor Mackenzie was succeeded in 1900 by Dr. John A. Amyot, under whose direction the laboratory has grown from small beginnings to large dimensions. An experimental station was established for practical demonstration of water purification and sewage treatment. The station and the laboratory continue to employ a considerable number of active scientific workers. In 1910 Dr. Hodgetts became Medical Adviser to the Conservation Commission of the Dominion of Canada and was succeeded by the writer, under whose regime the Public Health Act was revised and consolidated, a system of District Officers established and a Provincial Sanitary Engineer, Mr. F. A. Dallyn, C.E., appointed.

The District Officers were appointed under the Public Health Act of 1912, which provides that the Province may be divided into ten districts to each of which a legally qualified medical practitioner may be appointed. These officials are full time men and their salaries and expenses are paid primarily by the Government, which is in turn recouped by the groups of counties embraced in the various districts. In the unorganized portions of the Province the government pays its proportionate share of the expenses. At the outset the province was divided into seven districts, as shown by the accompanying map.

All of these officers had been medical practitioners of first-class standing in the province, and before entering upon their duties had a course of training in sanitary work provided by the Provincial Board and the University of Toronto.

Their duties are briefly set out in S.S. 7 of Section 13 of the Act as follows: "Every District Officer of Health shall within his district enforce this Act and the Regulations and any other Act or Regulations respecting the health of the inhabitants of the district or their protection from communicable disease and generally do within the district anything which a member of the Provincial Board, medical officer of health or sanitary inspector is authorized or required to do under this Act." While their special duties are confined to their respective districts, these officers are liable for duty in any portion of the province. They are under the control and supervision of the Board and report monthly or oftener as required. The jurisdiction of each of these officers being over such a large area it seemed desirable that the earliest of their duties should be to gain an acquaintance with their respective territories as soon as possible. With this object in view information relative to the sanitary conditions of the various municipalities under their care was sought and classified as far as possible under the headings of a schedule (see appendix). In this manner the acquaintance of the local officers, boards of health, municipal and county councillors was readily attained, and the co-operation of the various bodies secured. In all cases the officers report that there is a very marked demand for and apparent appreciation of their services, and in the short time during which they have been in office the Board has received from numerous quarters expressions of appreciation of their work and approval of the legislation which has established this system.

The story of their year's work is briefly set out in the short reports of each officer included herein, and it is only necessary to say that in this short time they have performed valuable services to the province by their efforts in improving the sanitary conditions in numerous places; in assisting municipalities having outbreaks of communicable diseases; in advising local Boards of Health and local Medical Officers of Health in difficult problems; in developing a demand for medical and sanitary inspection of schools; in spreading general sanitary knowledge in connection with the health exibit lectures among the public and relieving in no small manner the executive of the Board of serious and difficult questions.

Were the territories of the District Officers less extensive they could do better work, or at all events work which would at an earlier date show more fruit. The Board is satisfied, however, that a good beginning has been made, and that the intelligence of the great mass of our people needs only to be aroused, and supplied with knowledge of sanitary questions to make them alive to the value of a sound sane public health.

The good work which our men are doing will no doubt, before long, be the best reason for increasing their number.

The work done by the District Officers has been ably supplemented by the various Medical Officers of Health, who to the number of some 750 or more serve usually for small remuneration the townships, villages, towns and cities of the province. It is regrettable that the good work done by the Medical Officers of Health in smaller communities is so little appreciated and poorly paid. Some improvement, however, has been made by their permanency under the Act of 1912, and it is encouraging to see that a number of the municipalities have increased the remuneration during the past year.

A list of the various Medical Officers of Health and Secretaries of the local Boards of Health of the municipalities with their addresses is for convenience given in the appendix.

A brief report of each District Officer herewith follows:

DISTRICT NO. 1.

Comprising Counties of Elgin, Essex, Kent, Lambton, Middlesex and Oxford.

D. B. Bentley, M.D.

District Officer of Health, Sarnia.

During the thirteen months preceding the 31st December, 1913, I have visited the local medical officers and their boards in forty-four municipalities, and have endeavored to interest them in the work of preventing communicable diseases, by giving careful attention to what I consider the duties of a medical officer to be, viz.:

(1) To inspect every public and separate school and to report his findings to the local board, on the following points: heating, lighting, ventilation, cleanliness of buildings — water supply — for drinking purposes and whether proper provision is made for the pupils to wash themselves when necessary, particularly before eating meals; suitable basins and sanitary towels. Closets—are they clean? are they so built as to be proof against the entrance of flies and other vermin? are they ventilated? storm proof so that snow cannot drift into them? are the seats kept clean? are there walks provided so that children can get to them in bad weather without getting their feet wet? School-grounds—area? drained and graded or otherwise? plenty of room for play? shade? garden? medical inspection.

(2) To get acquainted with teachers and trustees and advise them in all matters having the improvement of sanitary conditions in view, and to impress them with the necessity of all suspected cases of communicable disease being promptly reported to him, by parents, teachers or family physician.

(3) To advise all residents in his municipality in matters pertaining to improved sanitary conditions surrounding the home, such as installation of sanitary privies, proper protection of wells from pollution by either human or animal excreta, cleanliness in handling food supplies—milk, butter, meat, fruit, bread, etc.

(4) To allow no unsanitary slaughter-houses within his municipality.

(5) To insist on all railway stations being provided with sanitary closets and urinals.

(6) To prevent the pollution of streams by individuals or corporations.

(7) To study the vital statistics of the province, of the county and of the municipality and make every effort to lessen the death-rate wherever possible.

(8) To cultivate the confidence of every member of the local board.

(9) Secure the services of an intelligent sanitary inspector and have him properly instructed in his duties.

Detailed sanitary surveys have been made in eighteen municipalities, reports of which are in the hands of the Chief Officer of Health. While making these surveys I took occasion to visit all the physicians possible and found that some of our worst communicable diseases are not reported.

Typhoid Fever.

In November and December, 1912, I visited all the practising physicians in Walkerville, Windsor, Sandwich and Amherstburg and obtained lists from them of the cases of typhoid fever treated by them during that year, securing in all 128 cases. Of these, 99 lived in Windsor and Sandwich, and the City Engineer of

Windsor very kindly provided me with a map on which was shown the distribution of cases. This showed that the infection was widespread and general, reaching to all parts of the city where city water was used. About this time a provincial laboratory was in the city and the water was found to be bad all along the Detroit River. Chlorinating plants were installed by all these municipalities.

None of the 128 cases mentioned had been reported to the proper authorities, and as a consequence the local boards and the citizens generally were not aware of the constant existence in their midst of the disease. During the year there were twenty-five deaths from this disease in the county of Essex.

It appears that the chlorine treatment has not been successful in stopping the disease in the city of Windsor, for I again obtained lists late in the year 1913 from all the physicians except two, one of whom was ill at the time of my visit, and I found that at least sixty-three cases had been treated in the city during the year. Fifty-nine cases were treated in the Hotel Dieu, and these patients were registered as from Windsor forty, Walkerville four, Ford City one, Sandwich three, other places eleven. Some of the physicians had reported all of their cases and others had failed to report any.

The same may be said in regard to Sarnia, as I found that for the year ending September 30th, 1913, there had been treated in the General Hospital forty-one cases, thirty-two being resident in Sarnia, one, a visitor from the west, had been in Sarnia about two weeks when taken down, five from other parts of the County of Lambton, two from Detroit and one from London. No cases were reported until the physicians had been reminded of their neglect, and such reports are too late to be of any use to the medical officer of health.

Chatham hospitals received during 1913 for treatment forty-nine cases, eleven from the city, twenty-one from Wallaceburg, four from Chatham Township, nine from Dover Township and four from Harwich Township. No cases were reported at the time of taking down.

St. Thomas Hospital (Amasa Wood) admitted sixty-one cases in 1913, fifty of which resided in the city. None reported properly.

Woodstock General Hospital admitted up to Oct. 24th, 1913, eight cases, five residents of the city, and the others from outside the city.

On the 4th of October I visited Forest to investigate a case of suspected typhoid fever. The local board of health became alarmed for the safety of their milk supply, which was in the hands of one dealer, and asked for an investigation.

The dealer's son, who helped on the farm and assisted in the milking and other care of the milk, took a trip to Sarnia and Detroit on the 15th of August. On or about the 29th of August he was taken ill, and on the 29th of September died. A competent nurse was placed in charge by the attending physician, who said he had an infection of some sort, was feverish throughout the course of the disease, had hemorrhages from the bowels and died from paralysis of the bowels. When the nurse took her rest the mother of the young man took charge of the patient. She also helped in taking care of the milk, and it was due to this fact that the local board took the steps they did. The definite period of incubation, the fever, the hemorrhages, the admitted disinfection of stools by the nurse, and the death appeared to me positive proof of the character of the disease, and that the Town of Forest could not afford to take any chances in such an important matter as their milk supply and were perfectly justified in stopping its sale from such a suspicious source until all danger had passed.

Unfortunately the dealer, owing to the assurances of the attending physician that it was not typhoid, could not see the justice of the Board's action, and felt very much aggrieved, so much so that when the ban was removed he would not start his business again. The attending physician too felt that his professional dignity had been injured, but I would advise any and every local board of health to take the same precautions under similar circumstances. The protection of the citizens is of vastly more importance than the personal feelings of any single individual.

This dealer had one of the cleanest dairies it has been my privilege to inspect. and every praise is due to the manner in which he conducted his business. It is a matter of regret that the view point of the local board could not have been impressed upon him by those nearer to him than the servants of the people, for then an important object lesson in preventive medicine would have been cheerfully learned and one good milk-dealer would still be in the business.

Smallpox.

On March 19th, 1913, I investigated an outbreak of smallpox in Essex County. On my arrival in Windsor that evening I called a meeting of the Health Officers for Windsor, Sandwich W. Walkerville, Ford City and Sandwich E. Drs. Ashbaugh, Durocher, McCormick, Little and Poisson together with Dr. H. R. Casgrain, a member of the Provincial Board of Health, met me and we obtained a list of fifteen cases. We then arranged plans for a thorough inspection. One Public School in Sandwich E. was visited and all the pupils vaccinated and the school closed. Several homes were visited and quarantined. All were placed under proper supervision. One man with a light attack was found to have been working in an automobile factory, so a general vaccination of all the employees was ordered and every assistance given by the employer to have the order carried out. The home of this man, in which there were two cases, was quarantined.

In Sandwich W. Dr. Durocher had several cases under effective quarantine. His diagnosis was confirmed and upheld. All of these officers were alive to the situation and worked together for the suppression of the disease. No cases were discovered in Windsor or Sandwich.

In December a young man who was supposed to have chickenpox while living in Walkerville, not being isolated, went to his home in Florence, and two weeks later his mother and one of his companions were taken down with smallpox. Other cases developed later. The extreme care taken by the local medical officer of health quite probably averted an epidemic of large proportions. This case emphasizes the necessity of isolating all cases of suspected chickenpox until all doubt is removed as to a positive diagnosis.

Isolated cases of smallpox were seen in Lobo (County of Middlesex), Plympton (County of Lambton) and Blenheim (County of Oxford) Townships. The Plympton case was in a family which had recently returned from Saskatchewan, the father being afflicted, the children and mother were vaccinated and were thus protected, no other cases occurring.

The Blenheim case was a man who had been away from home and had evidently contracted it on the train.

I have found that there has been great carelessness on the part of parents, teachers and physicians in the matter of reporting typhoid fever, tuberculosis, chickenpox, measles, mumps and some other diseases which should be reported. In some cases this neglect is due to the local boards not providing the physicians with the proper forms, but in some places where this is done no reports are sent in,

and I have urged the local boards to make a special effort to get these reports from some source early enough to be of value to the medical officer of health, pointing out to them that he cannot prevent the spread of disease unless he knows where the centres of infection are.

Slaughter Houses.

In about twenty municipalities I have had the local medical officer of health and as many of the members of his local board as possible accompany me on a tour of inspection of the slaughter-houses and dairies doing business in their locality. The result in many cases has been to convert some lovers of a meat diet to be strictly vegetarians until such time as they have satisfied themselves that conditions are absolutely changed in and around the slaughter-houses. In nearly every instance we found undoubted evidence that offal and blood of slaughtered animals was being fed uncooked and often in the putrefactive stage to hogs, that the floors and walls of the place were reeking with the blood and filth of years, that very little if any attempt was being made to observe ordinary cleanliness in the handling of meat intended for food. that slaughter-house, bone-bin, horse-stable, hen-house, drive-shed, etc., were often under the same roof, together with a foul smelling hog-pen, and that even when these unsanitary conditions were pointed out to those responsible for them great surprise rather than shame was the only manifestation shown.

Dairies.

The dairies were not quite so bad as the slaughter houses but there were only a few which were worthy of praise. In some the stables were well kept, the cows clean and in good condition but the cooling arrangements and milk house defective. In others everything else but the fact that the cows were dirty was all right. What is required is a better understanding between the dealers and the local boards as to what constitutes a sanitary outfit for the milk trade and the defects I feel sure will soon be remedied. The local boards must first inform themselves on these matters and then they can go to the dealers with some degree of assurance and let their requirements be known.

School Inspection.

In response to an invitation from the Women's Institutes of North Middlesex I spent about two weeks. accompanied by a School Nurse, Miss Sara Brick, of Toronto, inspecting the children in one High School, one Separate School and twenty-two Public Schools. We examined in all 821 pupils and found 432 suffering from defects of some physical character. The total number of defects was 659. After our inspection the nurse made 191 visits to the homes of the pupils and advised the parents as to our findings and what it meant to the pupil trying to compete in school work with those having no handicap and urging upon them the necessity of consulting the family physician with a view of having the defects remedied and the child placed on an even footing with his fellows. Notification cards of each defective child were left with the parents, and individual history cards written out for each defective child for reference in all the schools. Nine of the pupils have since had diseased tonsils and adenoids removed and some with defective vision have been fitted with suitable glasses.

Health talks were given to the children in each room visited and it was a

source of great pleasure to meet the large number of parents who turned out to the inspections.

Where I found unsanitary buildings, closets, or unprotected wells the trustees were notified to remedy the defects.

Our schools should be cleaned every week, but I find they are seldom cleaned more than once or twice a year. The floors and seats in the privies are invariably too dirty for use by any self respecting child, they are open to flies in summer and admit snow in the winter, many have doors off the hinges and they are generally unfit for use. Some schools have a poor water supply, or none at all; none have provision for children to cleanse their hands properly before eating, heating is often defective, ventilation poor, lighting defective, air space inadequate, grounds too limited, wet, and in need of draining.

These are observations made while inspecting the schools of North Middlesex and they apply to all the out-door privies which have come under my observation in the towns and villages where I have made a sanitary survey. They are also corroborated by the reports of local officers who have made inspections.

Some of the towns and villages which have been inspected are served by running streams of spring water which should be made beauty spots and thus add to the healthfulness of the place, but the citizens seem to look upon them as a fitting place to build privies, thus allowing human excreta to run through the town. Others, and particularly the business men who have stores on the banks of streams use the stream and its banks as a dumping place for all kinds of waste, such as old cans, ashes, decayed fruit, etc. In many places the citizens endeavor to have sanitary conveniences in their homes and are using ordinary drains to carry off the sewage.

Organization of Medical Officers of Health.

There are so many matters requiring the attention of good live local boards and active medical officers, that I have attempted to organize the medical officers and their boards in each county, in order to get all working at the same time in the municipalities adjoining each other. towards the same end. The first meeting of this kind was called in Windsor on Nov. 4th, 1913, and two-thirds of the medical officers of health attended the meeting. some having their sanitary inspectors and some members of their local boards along. The following subjects were discussed, special papers being prepared by the local men.

The Public Health Act.

Duties of a M.O.H. in a city, in a town and in a rural municipality.

Present conditions under which our food supplies are prepared, viz.: meat, fish, bread, milk, etc.

Very interesting and instructive papers were read and the discussions were joined in heartily.

At this meeting I outlined the work which was considered of the most urgent importance and since that time I have every reason to believe that most of the local boards are doing the work in a more systematic manner and with good results.

An Association of the same kind has been formed in the counties of Kent and Elgin, and meetings are to be held quarterly. Great interest was manifested in these meetings as was evidenced by a large representation of medical officers and their boards.

In all of these counties the local meat dealer is required to file with the clerk of the municipality in which his business is carried on an affidavit as to

where all meat sold by him is slaughtered. This is followed up by an inspection of the slaughter-houses and improvements demanded where necessary.

Many of the medical officers are inspecting the schools as to sanitary conditions and urging for much needed improvements. The plan of campaign as laid down on the first part of this report under: "Duties of Medical Officers of Health," is being followed.

In Oxford County more work is being carried on than formerly though the organization meeting was not so well attended as was desirable, but several of the medical officers have written me explaining why they could not attend and expressing their hearty approval of the movement.

The public health exhibit with moving pictures only touched three places in my district this year, Norwich, Woodstock and London. It drew good houses at the first two places but was not very well advertised in London so was greeted with a small audience.

All the County Councils in the District were visited and an address given in which the plan of campaign for improvement in sanitary conditions was outlined. The members of the County Councils were urged to give their active and moral support to their local health organizations, in their efforts to suppress the ravages of communicable disease, and the necessity of all parents, teachers, physicians and public officials joining forces for prompt reporting of cases was urged.

The houses of refuge, county gaols, hospitals and other public institutions in the district have been inspected and complete reports sent in.

Special visits have been made to twenty municipalities from which complaints in regard to nuisances have been received and the same remedied wherever possible. Local boards are being encouraged to have inspections so carefully carried out that soon their will be no cause for complaint.

A nuisance in the form of an old sand pit containing all kinds of filth, stagnant water, etc., which had been allowed to exist for some years by the local board of health, and the Council of the City of London, was this year filled in by order of the Provincial Board of Health, and the account paid by the City Treasurer on presentation.

County Medical Societies in Lambton, Essex and Oxford have been attended during the year, and the work of the health department presented to the members of these important bodies. The requirements of the Public Health Act, in so far as it applies to physicians were fully discussed. There is a strong feeling among the members of the medical profession that they are deserving of remuneration for the clerical work necessary in making out reports of births and deaths, and I am sure that these matters will not receive the attention they should until some definite fee is forthcoming for that work.

The West Lambton Teachers' Association invited me to give them an address at one of their meetings which I gladly responded to. We must have the support of the teachers in the work of preventing disease, and I have advised the local officers to take advantage of every opportunity to get acquainted with teachers, and interest them in the work.

The school inspectors of my district have shown a deep interest in our work and are giving us their hearty support. I have visited most of them and found them ready and willing to give assistance when necessary.

The press in nearly every town visited have had a representative attend meetings or have an interview about the local conditions requiring attention, and in every instance have given prominence in the papers to such discussions. In this way the general public is reached and become interested.

The work of the first year or better in No. 1 District has been very interesting and I believe has had the effect of creating a deeper interest in the great possibilities for improvement in sanitary conditions, in preventing disease, and adding to the happiness of our citizens. Once the public conscience is aroused our municipal officers, boards of health, physicians, teachers, inspectors, and other officials will receive the full support and assistance of the general public, in the conscientious discharge of their duties.

DISTRICT NO. 2.

Comprising Counties of Bruce, Dufferin, Grey, Huron, Perth, Waterloo and Wellington.

T. J. McNally, M.D.

District Officer of Health, Guelph.

This being the first year's work under the Revised Public Health Act of Ontario and in pursuance of the policy inaugurated by the Provincial Board, the regular work of compiling a complete sanitary survey of each organized municipality has been carried forward as rapidly as possible in the time at my disposal, after attending to such outbreaks of communicable disease as required assistance being extended to the local officer of health for their control.

In compiling the sanitary surveys it has been my aim and duty to verify, as far as possible, the accuracy of all facts and conditions so reported, as these surveys are very comprehensive as well as complete. Much time and care has been required for this part of the work and this may be better appreciated when it is recalled that this survey is the most extensive ever undertaken, so far as I am aware, by any department of public health in the world.

The sanitary survey has been completed in 31 towns and villages, one city, fifteen townships and several unorganized villages in the townships.

After this survey was taken in each municipality I had a public meeting called, to which the council, board of trade, school trustees and board of health were specially invited, and delivered an address on Public Health especially as affecting the particular municipality.

During the year the Moving Pictures and Public Health car of the Department were exhibited at twenty-seven places in the District, where Mr. Jones explained all points of the exhibit to visitors.

The moving pictures were used at 35 meetings, at which addresses were given on Public Health and Preventive Medicine. These meetings occupied our attention for six weeks constantly, but the time seems to have been well spent since I find as a result considerable new interest aroused in the provisions adopted by the Board for greater efficiency in the guarding of public health.

This awakened interest is very apparent in the cordial co-operation of the citizens with the local authorities for the correction of unsanitary conditions or the control of communicable disease by the District Officer.

Smallpox.

In the District during this period nineteen outbreaks of smallpox have required assistance and a visit to the municipality, while in several cases a number of further calls were required before the disease was finally blotted out.

In this connection nine addresses were delivered dealing with the nature of the disease and the means by which it is usually communicated, also the protection given by vaccination resulting in a very general acceptance of this means of stamping out the epidemic.

In connection with the mild type of this disease with which we have been dealing it is pleasing to note that our local officers are now generally recognizing it promptly.

In one instance it was found that chickenpox was being quarantined as smallpox and the quarantine was removed. Another case reported as suspected smallpox was found to be chickenpox.

For the control of other communicable diseases it was found necessary to make special visits to fourteen municipalities and five of these required repeated calls before the outbreaks were subdued.

Five municipalities were visited in company with the Provincial Sanitary Engineer and special advice and reports given as to sewerage and water supply.

Slaughter Houses.

The condition of slaughter-houses called for about twenty special visits for correction of unsanitary conditions, and in this connection it seems advisable that the requirements for a sanitary slaughter-house, should be placed in the hands of medical officers for their guidance.

The care of tuberculosis demanded three municipalities being visited for its control and in about one-half of the corporations of which a sanitary survey has been made return calls were asked for to assist the local authorities in obtaining improvements recommended when making the survey.

I was consulted seventy-five times by correspondence or wrote giving instructions regarding communicable diseases.

Sewerage, water supply and nuisances led to advice and instructions being given by letter forty-seven times and other matters in connection with the work led to considerably over one hundred communications.

In reviewing the work a marked improvement is apparent in the efficiency of the service performed by the local authorities under the new conditions for control of communicable disease, improved sanitation and general care of public health.

I would respectfully submit that if some arrangement by which reports of cases of communicable disease could reach the district office more quickly it would enable me to check up outbreaks more promptly, and it appears to me that all cases of death from communicable disease should be notified to the district office at once as this is too frequently the only report made of these diseases.

There is another matter to which I would respectfully call attention and that is the fact that in many of our schools there is not proper or sufficient fire escapes, especially from the third storeys of the buildings. This may not be our special care, but it directly affects the lives and welfare of our children, so I take the opportunity of thus calling attention to the condition. I have in several aggravated cases called attention to this in my regular survey which I believe has been forwarded to the Department responsible, but the condition still obtains.

In regard to railways whether steam or electric I would ask the consideration of the Provincial Board as to the advisability of instituting some regular care of sanitary conditions under supervision by the Department at terminal points as to water supply, care of tanks, disinfection of cars, supply of water for washing, etc., as so far as I have been able to learn there is no provision for this.

DISTRICT NO. 3.

Comprising Counties of Brant, Haldimand, Halton, Lincoln, Norfolk, Peel, Welland, Wentworth and York.

D. A. McClenahan, M.D.

District Officer of Health, Hamilton.

We began work in this District about the middle of November, 1912, after having spent three and one-half months in Toronto taking a special course in Bacteriology and Sanitary Science. Lectures were delivered by Doctors Amyot, McCullough and others. The lectures were eminently practical and were much appreciated by the district officers. The work undertaken in the latter part of November and in December, 1912, was the visiting of the public institutions in the district and the making of a special report upon each to the Board. The gaol, general hospital, sanitarium, house of refuge and institute for the blind in the city of Brantford were all visited and special reports as well as special recommendations made. The General Hospital, St. Joseph's Hospital and other public institutions in the City of Hamilton were also visited. In addition to these the public institutions were visited and reported upon in St. Catharines, Niagara Falls, Welland, Cayuga, Simcoe, Milton and Toronto.

During January of 1913 the county councils in my district were visited, or as many of them as I could during the time they were in session. I visited the Councils in York, Halton, Lincoln, Welland and Wentworth. I was cordially received in every place and co-operation in dealing with public health problems was promised by the members.

Smallpox.

During the month of February, 1913, a rather serious epidemic of smallpox broke out in the city of Niagara Falls, Ontario. There were no deaths from the disease, but some of the patients were very ill. The infection was thought to have come from Niagara Falls, N.Y., as the disease was prevalent there at that time, and from a public health standpoint the two cities are practically one. I am enclosing here a rather detailed account of the outbreak, as I think it is interesting enough to make public. I spent about three weeks in Niagara Falls trying to assist the local board and the M. O. H.

The first cases developed at the Tremble House near the M. C. R. station. At first the cases were isolated in the house, and the contacts were all vaccinated. One difficulty presented itself early and that was the fact that there was no Isolation Hospital, and besides there was no place to quarantine the contacts. After some two or three weeks a temporary Isolation Hospital was established, and then the cases were all sent there. Most of the cases were of a mild type, but some few were severe. It was sought to vaccinate the people at first by using moral suasion, but this was slow and tedious work and finally on the threat of the Provincial Board of Health to quarantine the city the Council voted to issue a Proclamation for general vaccination. At the same time a house to house canvass was made of the city, and a general house-cleaning established and carried out. I fancy about seventy-five per cent. of the people obeyed the proclamation, and as the school children had been previously vaccinated, the epidemic was stayed. There were in all forty-five cases. No untoward results occurred in any case of vaccination and some thousands were done.

The following is a list of the cases, with information as to whether the patient had been previously vaccinated or not, and also the number of exposures from each case, and whether the people exposed had been vaccinated or not and the number who contracted the disease:

The Tremble House.

There were six cases in this house. Four of them had never been vaccinated, two vaccinated, one thirty years ago and the other eighteen years ago. There were eight other people exposed in this house—a boarding house—all of them had been vaccinated and none contracted the disease.

Legett House.

Four cases of smallpox. Three had never been vaccinated and the other one was vaccinated twelve years ago. Ten other people exposed all vaccinated, none contracted smallpox.

McDonald House.

Two cases of smallpox. One vaccinated thirty years ago, one never vaccinated. One other was exposed, but had been vaccinated and did not take smallpox.

Carter House.

One case. Vaccinated thirteen years ago, not much of a mark on arm. One other person exposed, who had been vaccinated and did not develop smallpox.

Nybra House.

Four cases all unvaccinated. Eight other people were exposed. These had all been vaccinated and none took the smallpox.

Farrell House.

One case. Had not been vaccinated. One other person exposed, had been vaccinated and did not develop smallpox.

Leslie House.

Two cases, both unvaccinated. Three other persons were exposd who had been vaccinated and did not show smallpox.

Hughes House.

Three cases, all unvaccinated. Six other people were exposed who were all vaccinated and none took smallpox.

Roszel House.

Ten cases. Nine unvaccinated and the other one vaccinated twenty years ago. Three other people were exposed who had been vaccinated and did not show smallpox.

Putnam House.

One case. Unvaccinated. Three other people exposed, vaccinated, no smallpox.

Rowe House.

Two cases—both vaccinated. Two other persons exposed who had been vaccinated and did not take the smallpox.

Logan House.

One case, unvaccinated, six other people were exposed, all vaccinated. None of these took smallpox.

Cummer House.

Two cases, one unvaccinated and the other vaccinated thirty years ago. Six other people exposed all of whom had been vaccinated and none took the smallpox.

Allen House.

One case—vaccinated eight years ago. One other person exposed who had been previously vaccinated and did not develop smallpox.

Gardner House.

One case, unvaccinated. Six other persons exposed, all vaccinated, no smallpox.

Smith House.

One case, unvaccinated. Three other persons exposed who had been vaccinated and did not take the smallpox.

Lundy House.

One case, unvaccinated. Three other persons exposed who were vaccinated and did not take smallpox.

Sayres House.

Three cases—all unvaccinated. One other exposed who had been vaccinated and did not develop smallpox.

Baldry House.

Three cases, all unvaccinated. Four other persons previously vaccinated and did not take smallpox.

The Value of Vaccination.

In but six of the forty-five cases was there a history of vaccination, the other thirty-nine were unvaccinated people. In connection with these forty-five cases of smallpox there were seventy-six people who were markedly exposed but who had been previously vaccinated and did not take the disease. In nearly every case where the exposure was marked or the contact close, in an unvaccinated person the disease was contracted. The epidemic began early in 1913 and lasted well on to May of that year.

Sanitary Surveys.

During March of 1913, I began a sanitary survey of the town of Welland. A detailed report was made to the Board on March 25th. Welland is contemplating the establishment of a sewage disposal plant but have asked for more time on account of the fact that a new Welland Canal is being built which will change the water levels and might interfere with the plan they had formed. There is no doubt a disposal plant will be constructed as soon as the plans for the new canal are known. All the officials in Welland seem very efficient and were anxious to assist the district officer in every way.

Among other places visited during the month of April was the village of Bolton. This is a small village and up to the beginning of the year 1913 nothing much in a public health way had been undertaken. However, members of the Council and the Board of Health, particularly the M. O. H., Dr. Bateman and the Reeve, Mr. Leavens, were very energetic and anxious that something should be done to improve conditions. By-laws have been passed for the collection of garbage and night-soil, and also for the abolition of pit closets. The Council is also grappling with the question of a system of waterworks. Bolton is an object lesson to other villages and even larger places as to what may be done when concerted effort is made. This village is to be congratulated on having efficient and energetic officials. In the early part of May a sanitary survey was made of the Town of Oakville. We succeeded there with the help of the M. O. H., Dr. Fisher, and the Council in having a milk by-law passed and some other public health reforms instituted. To-day Oakville is one of the most up-to-date towns in my district from a public health standpoint. They have waterworks, sewers and sewage disposal plant. milk by-law, garbage by-law, communicable diseases are rigorously looked after, and last but not least they have a medical inspector of schools and a school nurse. Oakville is to be congratulated. Would there were more of the same kind!

Later in the year I made a survey of the Town of Milton. This town has a good system of waterworks but has no sewers and complaints are constantly being made by residents about surface water and creeks being polluted by sewage. Milton has a very efficient M. O. H. but is a little behind in public health matters. They might just as well take up seriously the sewage problem at once, as to wait five or ten years and then find themselves in no better position. They have practically everything to establish to be up-to-date in a public health way. I made a number of recommendations in my report but am not sure that they have all been carried out.

I cannot go into detail about every municipality but I have made sanitary surveys and detailed reports of the following places in addition to those already mentioned: Beamsville, Grimsby, Cayuaga, Caledonia, Burlington, Dundas, Hagersville, Simcoe, Georgetown, Richmond Hill. Mimico, Thorold and others. In addition a large number of complaints, made either to myself direct or to the secretary of the Provincial Board of Health were investigated and special reports made to the Board. In the fall of 1913, we had epidemics of typhoid, at Mount Hamilton, Lynden, and at Niagara Falls. At Mount Hamilton there were about a dozen cases. A general clean up was ordered by the township authorities. The cases were passed around by contacts and flies. The closets were of the pit variety and were unscreened. The well water was also found to be polluted. At Lynden a similar outbreak of some sixteen cases with two deaths occurred. There the wells were also found to be infected and the same causes operated as in those at Mount Hamilton.

At Niagara Falls there were during 1913 about one hundred cases of typhoid. The great majority of the cases occurred between the 1st and 15th of August. After investigating all other possible sources of infection Dr. Logan, M. O. H., came to the conclusion that the city water was at fault. Samples when examined showed the presence of Colon bacilli. A chlorinating plant was put in and the water was treated up to Nov. 1st. Since then the water has not been treated. It would be the part of wisdom for the authorities at that city to consider the putting in of a permanent apparatus for the treatment of the water supplied to the citizens.

I visited in the autumn the Public Health Association meetings at Regina and Colorado Springs. It was a long tiresome journey but we were amply repaid by the excellence of the papers read and their practical discussion during the various sessions.

I am perhaps not over-sanguine in thinking that some useful work has been done during the past year. Of one thing I am very sure and that is that much remains to be done. I have attended a large number of public meetings and addressed audiences in the hope that by such methods public health work may be popularized and the work made more easy of accomplishment. The pleasure of the work has been contributed to in no small degree by the consideration, direction and assistance of Doctors McCullough, Bell and Amyot and also by Mr. Dallyn, the Engineer of the Provincial Board of Health.

DISTRICT NO. 4.

Comprising Counties of Durham, Haliburton, Hastings, Muskoka, Northumberland, Ontario, Peterborough, Prince Edward, Simcoe and Victoria.

GEORGE CLINTON, M.D.

District Officer of Health, Belleville.

Detailed sanitary surveys have been made and reports sent to the Board, of two cities, eighteen towns, twenty-three villages and sixty-four township municipalities. All government institutions and public buildings, as well as town schools, have been visited and reported on.

At the Asylum for Feeble-Minded at Orillia, I found the sewage was discharged into Lake Simcoe untreated, windows and doors not screened during the fly season. I recommended treatment for sewage and that all windows in kitchen, dining-room, and hospital wards should be screened, and am pleased to note that an appropriation was made by the Legislature in the Session of 1913 for this purpose. In all other respects it appears to be a model for the class of patients or inmates there.

At Penetanguishene Asylum I found conditions much the same as Orillia, and likewise an appropriation has been made to correct the unsanitary condition.

In almost all the cities, towns and villages I found the authorities were willing to try and improve the sanitary conditions when shown it was for the benefit of the public.

During the month of January, 1913, I met and addressed the County Councils of Simcoe, Ontario, Northumberland and Durham, also Hastings, dealing with many changes in our Health Act, and in each and every case was shown the greatest of courtesy.

In June I met the County Councils of Peterborough, Prince Edward, Victoria and Haliburton, with like results.

During the summer of 1913 I visited and inspected fifty-two summer hotels, sixteen canning factories, and four lumber camps. Nearly all were in a fairly good sanitary condition. Those that were deficient were notified that unless the deficiency was corrected they would not be allowed to continue business next season. These hotels are nearly all located on the Muskoka Lakes and the Kawartha Lakes. All that have water works with closets and baths have septic tanks and sub-soil drainage. The others, as well as the private cottages, have dry earth closets. Garbage in all these resorts is well taken care of.

The Muskoka Lake Navigation Company have installed tanks from flush closets which will be sterilized by steam before emptying in lakes, in four of their largest boats, and expect to have the balance of the fleet likewise fitted out the coming season.

The Huntsville and Lake of Bays Navigation Company, as well as the Stoney Lake Navigation Company, have been notified that they also will have to make proper provision for the disposal of sewage from their boats, so that they will not pollute the inland waters. Other smaller lines have also been notified.

Slaughter-houses in the rural districts as a rule were poor—many bad. In some cases it was necessary to condemn them completely and prohibit their use. Others were willing to make improvements that were suggested. I observe that 200 yards from any dwelling-house, in many places, is not practicable, and suggest that this should be governed to some extent by the medical officer of health?

In March, 1913, I was called to Warkworth by Dr. Armstrong, Medical Officer of Health, and found a well marked case of smallpox in drying up stage. Previous to this a woman from Manitoba, a former resident, came home for a visit and was taken ill with supposed la grippe. The doctor only saw her before the rash appeared. Consequently she was visited by relatives and friends, and as a result I located in the surrounding township about fifty cases. From here it was taken to Campbellford and Seymour Townships, and sixteen cases resulted. In Campbellford compulsory vaccination was ordered, and by this means the disease was soon under control. In all these the medical officer of health and local authorities acted promptly. I visited Campbellford twice in connection with this epidemic.

Early in the year Collingwood had an epidemic of smallpox. In April and May thirty cases, and two in midsummer. The medical officer of health and local board of health were alert, and closed all schools, churches, lodges, or any public meeting places, until the epidemic was stamped out. General vaccination was established. The medical officer of health wisely placarded and quarantined all cases reported as smallpox or chickenpox.

In October it was reported to me that the carrier of the rural mail in Tyendinaga Township had smallpox. The local medical officer of health was notified and instructed to quarantine and vaccinate all parties exposed, to fumigate the mail bags, mail on hand as well as all the rural mail boxes. Two schools and cheese factory in the neighborhood were closed, hence only four families had the disease, nine cases in all, and no deaths occurred. The medical officer of health and local authorities did all that could be desired.

Summary of Smallpox Cases.

Collingwood, 30; Warkworth (Percy Tp.), 15; Campbellford, 10; Seymour Township, 6; Brighton Township, 30; Tyendinaga Township, 9.

In every case the medical officer of health and local board of health were alert and willing to adopt any suggestions I made.

The following places were visited more than once for special work:

Trenton, 4; Brighton, 2; Campbellford, 3; Madoc, 3; Wellington, 4; Honey Harbor, 2; Port Hope, 6; Cobourg, 3; Havelock, 2; Bobcaygeon, 2; Point Ann, 2; Penetang, 2; Collingwood, 3; Midland, 2; Lindsay, 2; Peterborough, 6; Oshawa, 3; Whitby, 4; Picton, 5; Barrie, 3.

I spent three days in Wellington in abating a nuisance which I could not get done by the local board.

During 1913 waterworks have been installed in Brighton and Bowmanville. The latter town is also putting in sewers.

At Muskoka Station (C. P. R. divisional point) the sanitation has been bad, There were nine cases of typhoid in November and December, with one death. I gave them notice that they would be prosecuted without further notice unless the nuisance was abated without delay. A prominent official of the C.P.R. replied that they would act at once.

In a number of the railroad stations the old pit closets have been replaced by flush closets or dry earth closets. At Mt. Julien, Stoney Lake, I had a septic tank and sub-soil drainage established.

Burleigh Falls has a septic tank, but no treatment for effluent. Have given them notice that unless this condition is corrected they would not be allowed to do business in 1914.

During the year I have met and addressed several medical societies, Farmers' and Women's Institutes, and, with the influence of the ladies, we have valuable aid in our work, and through them hope to get medical inspection of many of our school children.

All through my district I have been met with courtesy and a seeming desire to aid me, both by the local boards of health and the medical officers of health. yet there is much to do.

DISTRICT NO. 5.

Comprising Counties of Addington, Carleton, Dundas, Frontenac, Glengarry, Grenville, Lanark, Leeds, Lennox, Prescott, Renfrew, Russell and Stormont.

PAUL J. MOLONEY, M.D.

District Officer of Health, Cornwall.

The following is an epitome of the work performed in District No. 5 by the district officer under the supervision of and by the direction of the Provincial Board of Health.

The work may be classified under the headings of:

(*a*) Public Lectures.

(*b*) Inspection of Public Institutions.

(*c*) Sanitary survey of cities, towns, villages and rural municipalities.

(*d*) Investigation of special conditions and correspondence with matters relating to public health.

Public Lectures.

These were delivered at the county council meetings, teachers' conventions and associations connected with social work. The lectures dwelt chiefly on the provisions of the 1912 Health Act; our duties and obligations as district health officers; the work the Government had undertaken to eradicate tuberculosis, typhoid and other communicable diseases, and as a public health measure to see that citizens were supplied with as pure a water supply as possible; the duties and obligations of local boards of health and officers of health and general topics with reference to the public health.

Inspection of Public Institutions.

This included an inspection of the two asylumns and penitentiary in the district, ten hospitals, seven houses of refuge or old peoples homes, five children's homes or orphanages, seven county gaols besides the schools in all urban centres.

Sanitary Survey of Municipalities.

This consisted of a systematic examination and report on the sanitary conditions of the municipalities visited. In all thirty-nine such reports were made, entailing eighty visits to the different municipalities in this connection. The full reports in connection with these are on file with the Provincial Board of Health.

Investigation of Special Conditions.

Under this heading might be placed:

(*a*) *Investigation and action taken with regard to the outbreaks of communicable diseases.*

We have had quite a number of sporadic cases of smallpox in this district during the past year. They were almost invariably limited to the one family, and I found the local officer of health most energetic in preventing a spread of the infection to the surrounding community. Two epidemics in Prescott County got somewhat beyond control, and one in Hawkesbury was found very difficult to eradicate. In the latter instance the disease was kept alive by new infection coming from places outside of this district. In the former about fifty cases existed. An epidemic of diphtheria complicated with scarlet fever in the Village of Merrickville was a grave menace to the public health. Some laxness may have been apparent in the early part of this outbreak, but later most energetic and effective action was taken by the local officer with completely satisfactory results.

The typhoid rate, although not alarming, is still much higher in this district than it should be, and almost invariably the increased rate is most noticeable in municipalities where the citizens are supplied with water which proves contaminated on test. A marked improvement has in every case been noticeable where the water has been treated or otherwise improved in quality.

The new tuberculosis sanatorium at Kingston is doing good work, but as a whole in this district I do not think we have made very satisfactory progress during the past year in combating tuberculosis.

The inspection of schools in the district for the discovery of communicable diseases has made some, but not satisfactory, progress.

(b) The Investigation of Nuisances.

The chief sources of complaint in this regard have been in connection with the slaughter-houses. Very few indeed of the slaughter-houses in this district were found to be sanitary, the majority not being fit from a sanitary point of view to be places in which meats could be prepared safely for use as human food, while quite a number were found to be in a most deplorable condition. A great deal of trouble has been experienced with regard to the location of the slaughter-houses, a very large percentage being so placed with regard to surrounding dwellings as to make them contrary to the provisions of the Act. Energetic action has been taken to remedy the conditions in all cases, many of the establishments being closed up, but I have felt the need greatly of some standard regulation which we could insist upon all slaughter-house keepers living up to. The slaughter-houses in connection with the City of Ottawa being largely outside the corporation were marked offenders, and I strongly advised the city authorities to establish under municipal control a public abattoir. This suggestion has been taken up by them, and from present indications I think will be acted upon.

Cheese Factories and Butter Factories.

These institutions have been a frequent cause of complaint from nearby residents from the overflow of their whey tanks, causing very offensive odors. The buildings themselves on investigation were frequently found much infested with flies, although otherwise kept clean. The dairy inspectors have been energetic in insisting on cleanliness in the establishments, but do not seem to fully appreciate the injurious effect likely to be produced by the swarms of flies. The proper screening of windows has been ordered in all cases where these institutions were inspected.

Drainage.

Complaints with regard to pollution from drains have been very frequent, although very often of a minor character, and a letter to the local health officer is usually sufficient to have conditions rectified.

Many other complaints of nuisances caused by the presence of unsanitary conveniences, manure piles, tanneries, dead animals, etc., were reported and dealt with mostly by the local officers. The time spent in investigating these conditions often required only a few hours, but at times more than a week, as in the case of the nuisances complained of in connection with the drowned lands of the Napanee River.

(c) The Installation of Water and Sewerage Systems.

Eight municipalities called on me for expert advice with regard to the installation of sewerage systems in their municipalities. These were chiefly small villages of from 700 to 1,500 inhabitants. The principal difficulty they experienced in installing their plants was the expense in connection with a sewage disposal plant, very many of them, owing to their location, not being able to conduct their sewage to their disposal plant by gravitation owing to the want of fall. Plans are now prepared, or in the course of preparation for four such plants, and I expect that work will be proceeded with next year.

The pollution of the River St. Lawrence by the towns and cities on its banks, and also that of other rivers, has caused considerable concern. The enforcement of the Act under present conditions was felt to be a great financial burden upon the localities interested. Carleton Place and Napanee have installed up-to-date plants. In the cases of the City of Kingston and other towns their water supply was contaminated by their own sewage. Many of these places are contaminating the water supply of municipalities further down the stream.

Water Supply.

A system of municipal water supply is proposed in all cases where sewerage systems are about to be installed. The supply is generally not very satisfactory, and experiments in five cases are now being made with regard to the possibilities of artesian wells. Where the supply at present existing cannot be improved upon, chlorination has been ordered as in the cases of Kingston, Brockville, Gananoque, etc., or a filtration plant ordered, as in the cases of Perth and Carleton Place.

Correspondence.

A fairly large amount of correspondence was necessitated in carrying out work, in all approximately seven hundred letters were written.

I think a special note should be taken of the establishment of a piggery in connection with the garbage disposal system inaugurated by the town of Brockville. The fact that the most plentiful supplies of garbage in the town are taken away by private parties leaving the balance to be taken care of by the municipality tends to keep the present plant from being self sustaining.

The council are anxious to secure an amendment to the Act giving them more complete control over their garbage disposal.

The institution of Visiting Nurses in Cornwall with the intention of propagating a more sane knowledge of public health among the people is a step in the right direction, and I think it will be possible to extend the system to many of our towns and other municipalities.

As it is now recognized that the majority of diseases are caused by contact, I recommend that the Provincial Board make a regulation providing that facilities be made available for separate drinking cups on all trains and at all schools and public taps or fountains. For the same reason I recommend that individual towels be made compulsory at all hotels and public boarding houses.

Owing to the prevalence of diseased animals I think some kind of general inspection of animals slaughtered should be enforced.

I wish to record the great assistance I have received from the directions and advice of the officers of the Board in the carrying out of the work assigned to me in my district, and my appreciation of the opportunities afforded me to more perfect myself in public health work.

DISTRICT NO. 6.

Comprising the districts of Nipissing, Parry Sound, Sudbury and Temiskaming.

W. EGERTON GEORGE, M.D.,

District Officer of Health, North Bay.

Work started shortly after the beginning of the fiscal year, on November 20th, 1912. As it was required by an Order-in-Council that I make North Bay my headquarters the first two weeks were spent in securing suitable accommodation and making a sanitary survey of the town. From this time until December 31st, 1913, I travelled twenty-eight thousand eight hundred and sixty-seven (28,867) miles at a cost of Eight hundred and twenty-one dollars and forty-five cents ($821.45). This cost is chiefly hotel expense and transportation other than railroad. Six hundred written notices were given for the correction of unsanitary conditions. Beside these where the offender appeared to be anxious to comply and where the offence was not such as to admit of any serious results, numerous verbal notices were given. In forty-two cases informations were laid and police court resorted to; while in thirty-seven other instances proceedings were taken on my direction by the local authorities. The prompt response on the part of the people generally to any and every kind of complaint, even when the financial outlay was considerable, is a most encouraging sign of an awakening public conscience. Fifty-five dollars ($55.00), only, were collected in fines; an appearance in police court being sufficient in nearly every case to cause an immediate compliance. Magistrates were informed that it was not fines, but improved conditions, that I wished. Sixteen municipal reports and sanitary surveys were made in this district following a very comprehensive scheme supplied to me by the Board.

The assistance and kindness of the medical officers and local boards have made this work very pleasant, and alone have made part of it possible. One hundred and ninety-three official visits were made in seventy-seven municipalities.

Places at which two calls were made are: Timmins, Iroquois Falls, Englehart, North Cobalt, Trout Mills, Bonfield, Whitney, Katrine, Byng Inlet, Sellwood, Chapleau, Verner, Conniston, Espanola and Depot Harbor.

Three official visits were made at the following places: Golden City, Mattawa, Sturgeon Falls, Copper Cliff, Callander, Sprucedale and Scotia.

Four visits were made to South Porcupine, Cochrane, Earlton, Parry Sound, Powassan and Burk's Falls.

Five calls were made to Haileybury, Cobalt and New Liskeard.

Six official calls were made to Swastika and Sudbury.

COMMUNICABLE DISEASES.

The following diseases became epidemic and required personal visits:

Typhoid fever: Byng Inlet, Haileybury, Parry Sound, Sellwood, Henwood Township and Sturgeon Falls.

Whooping cough: Swastika and Depot Harbor.

Scarlet fever: McKellar Township.

Measles: Swastika, Depot Harbor, New Liskeard and Cochrane.

Smallpox: Earlton, Whitney, Bonfield, Swastika, Mattawa and South Porcupine.

Swastika has without doubt been a vulnerable spot. The explanation seems clear. The municipality is unorganized and there is no medical officer of health. This place has been the centre of a mining boom and for this reason it has been visited with a large floating population, thus exposing the municipality to any epidemic that might be prevalent within many miles.

Since the beginning of August when the Board began sending to me the returns of all cases and deaths within my territory, on the original cards which are required to be sent in weekly by the secretary of the local board of health of an infected municipality (Public Health Act, Section 24), two things have been made very apparent; first, secretaries of boards of health of infected municipalities are neglecting to make these returns; second, physicians are neglecting to make these returns to the medical officer or secretary. I have called the attention of the boards of health of two municipalities where epidemics have existed that these returns are not being made. A solution of the reporting of communicable diseases by physicians will, I believe, become more insistent as the discrepancy between the returns and the actual number of cases becomes known. I am already convinced that this is much greater than is usually thought.

An attempt has been made in a number of camps to have a quantity of vaccine used as a preventive for typhoid: but considerable difficulty exists in getting the men to submit to second inoculations as the reaction to first doses have frequently been quite severe.

During the Earlton, Whitney and Bonfield epidemics of smallpox there were some two hundred vaccinations performed.

Water Supplies.

The public waters in this district have had but little protection. Many, however, are without pollution because of the absence of population. The fact that no municipality in my district has yet established a sewage disposal system has not helped matters. Sewers are therefore emptying in all cases directly into public waters, with the possible intervention of septic-tanks, the value of which is now known to be small. Other water supplies where no sewers empty have been allowed to become summer resorts, thus exposing them to all the concomitant dangers. Boats plying such waters have become a matter of grave concern to many municipalities. In Depot Harbor and at Haileybury steamers frequently discharge their kitchen waste and w. c. refuse within a few feet of the intake pipe. Parry Sound and Haileybury are discharging their sewage into the waters from which they get their water supplies. New Liskeard, Cobalt and North Bay discharge their sewage into the water supplies of other municipalities or parts of municipalities. Sudbury is permitting a summer resort to be made of their water supply: while Cobalt has prevented a similar result by the energy of their Medical Officer and Board of Health for 1913. I am glad to be able to report that there are signs that the public are taking some interest in the procuring and maintainance of safe supplies. Late in the year I visited and made sanitary surveys of the proposed water supplies of the towns of Copper Cliff and Frood Mine. The water-sheds of these lakes (Meat Bird Lake and Whitson Lake) have been bought up and otherwise protected, permission having been obtained from the Provincial Board to prevent these waters from being used for any other purpose whatsoever.

In two municipalities it was found advisable to install filter plants in order to correct water conditions and render the water safe and potable. The Haileybury plant deserves special mention, as the results have been particularly good. In

the year between June 1st, 1912, and June 1st, 1913, a large number of typhoid cases developed (in round numbers 150 cases) with between 25 and 30 fatal terminations. During the months that this disease is specially prevalent, September, October, and November (1913), with the plant running, eight cases developed, with three deaths. No cases of the disease developed outside of the months mentioned. Water samples were sent to the Provincial Laboratories every week since this plant was put into commission, without even one suspicious report. As to the eight cases and three deaths, I believe these can be satisfactorily explained by carriers of which there must be a number, as the disease has been prevalent, with the exception of the last few months, each year since the big epidemic of 1908 and 1909. What further explanation as might be required would be furnished by the existence of a large number of open privies and flies. The system of filtration is mechanical; this was preferred because of the large amount of organic matter in the waters of Lake Temiskaming, and because the winter weather in this locality is so severe that artificial heat is required. The Bell pressure system is the one installed.

The other plant is at Burk's Falls, but is not yet in working order.

Sturgeon Falls was ordered to install a chlorinating system. Last summer being particularly dry the water in the Sturgeon River reached a very low level, with the result that an outbreak of typhoid occurred, twenty-five cases developing in one and a half months.

Sewage and Sewage Disposal.

The Public Health Act makes it very clear that raw sewage must not be discharged into any water in Ontario; and as this has been the invariable outlet, towns have been forced to consider means of protecting such waters by a more approved treatment than is supplied by septic tanks. To Sudbury belongs the credit of being the first in this district to undertake the building of a disposal plant; although there are places where necessity could even be said to be greater. Recently in the same town a much needed trunk sewer has been constructed. A quantity of raw sewage still finds its way into a creek as it flows through the centre of the town.

Parry Sound has a typhoid rate many times greater than it should be and there is not the slightest doubt that this is produced by its own sewage being carried to the intake pipe in more or less concentrated form by currents, the direction of which vary with the wind. The cases do not occur steadily, but in small groups when the wind blows from certain directions.

Typhoid in North Bay has never reached the proportions of an epidemic since Lake Nipissing has been discarded as a water supply in favor of Trout Lake. Such cases as do occur can usually be traced to Lake Nipissing where a considerable proportion of the population spend their summer evenings; and where they go to bathe. A number of hands from steamers on this lake had typhoid during last season.

Cobalt mixes the tailings of several mines with their sewage. This acts as a coagulant. The sewers discharge on a flat to the north of the town where the solid matter settles or is carried down by the tailings, while the water runs off in a little creek and empties into Mill Lake, thence through Mill Creek to Lake Temiskaming. Mill Lake and Mill Creek are used more or less as a water supply for cattle, especially for dairy cows. Because of the topography of the town part of the sewage has been emptying into Cobalt Lake. It is now the intention to drain this Lake for mining purposes thus making it necessary for the town to build a

trunk sewer north along the T. & N. O. Railroad, to Cross Lake. Cross Lake empties into Mill Lake and so we have a chain of lakes and streams down to Lake Temiskaming passing through a thickly populated community with the obvious dangers.

Haileybury and New Liskeard empty their sewage into Lake Temiskaming. Haileybury gets its water supply from this lake and hence the high typhoid rate which existed until their filter plant commenced operations.

The sewers in Cochrane discharge into a lake within the town limits, but they have promised the Provincial Board to extend their system beyond Marshy Lake where further danger will be almost nil.

One or two facts with regard to the cost of installation of sewers in northern towns are worthy of note. A frontage tax of one dollar a foot is charged on each side of the street, which is sufficient to meet the cost per foot of laying the sewer. At the street intersection (at the ends of a block) the cost is defrayed out of the general tax rate. In this way the property owners who are to benefit are required to pay a little better than two-thirds of the total outlay; the balance being assumed by the corporation. The small man (the poorer class) on the outskirts of the town is thus protected from a tax burden for that from which he receives but little advantage. I mention this because it is frequently used as an argument why the expense of a scavenger system should be borne by that part of a municipality not supplied with sewers.

None of the steamboats within my territory were found with storage tanks and disinfecting apparatus. In the later part of the season I inspected the Magnetawan Navigation Company's steamers, where chemical closets were permitted upon a written agreement being given that every care would be taken with the discharges and that permanent provision would be made in the winter months. The Grand Trunk steamers at Depot Harbor were ordered to install these tanks; but subsequent inspection was impossible before the close of navigation.

Dairies and Food Supplies.

The fact that milk is a very excellent and cheap food has made it an article of daily diet. This alone is sufficient to demand for it the continuous vigilance of the health authorities. But the ease with which it can be contaminated when associated with the carelessness in collecting it, in this district, cannot be viewed with anything but alarm. Last summer the Cobalt Council turned down a recommendation of the Board of Health for the bottling of all milk sold within the town limits, except in sealed-can lots to hotels and restaurants. The milk producers were represented by counsel who succeeded in having the town fathers turn down the recommendation without giving the Board of Health an opportunity to reply to the arguments presented. One of the first moves of the new Medical Officer, Dr. MacLaren, who was elected to the place so well filled by his colleague Dr. Hair, was to take up this matter of the dairies. Not only will they now be required to bottle the milk but all cows must be tested with tuberculin, and those reacting must be eliminated from the herd. In North Bay there has also been considerable attention given to the question of clean milk. Their new milk by-law is one of the best that I have ever seen, better I think than any for a town its size. One or two dairies have been prohibited from selling milk in the town. The milk in one place was found with a fat content below normal. The vendor was prosecuted as a warning to others.

I made a personal visit to all dairies in order that there would be absolutely no doubt as to the conclusions reached. Five of the worst offenders were made to appear in police court which went a long way toward stimulating improved methods and conditions. One place in Haileybury was so filthy and the opportunity to maintain it in sanitary condition so small, that I ordered the place closed. The temperature at which milk is delivered to consumers is one which has received little or no attention in my territory, the only reference being in North Bay's new milk by-law which places this at 55 degrees Fahrenheit. Many milk wagons do not provide for keeping milk cool in warm weather, while sleighs used for winter delivering are not such as will keep the milk from freezing. Freezing breaks the seals and exposes the milk to infection from dirty handling. Full cans are frequently allowed to stand on station platforms in hot summer weather, undoubtedly causing much souring. Pasteurization has not been attempted. In Haileybury they are considering a proposition for the pasteurization of all milk for use in Haileybury, Cobalt and New Liskeard. Bacterial counts are so impracticable that I have recommended the use of an absorbent-cotton strainer such as is used in Toronto. While I am able to report wonderful improvement there are still eight of these dairies in which the proprietors have shown such rudimentary ideas of cleanliness that I am convinced that they should not be in the business. The number of personal invitations and intimations I am receiving is a sign that the public is beginning to demand better things. There is no doubt also that this indicates that the dairies are at present requiring further attention.

Efforts were made during the past year to prevent the display of fruit in front of stores, and these met with moderate success in Cobalt, Sudbury, Haileybury, New Liskeard and North Bay. Continuous watchfulness will be required through the coming year, especially in North Bay, and until such times as the public become aware of the advantages of its protection. Evidence is not wanting to convince one that no great time will be required. Foreigners are the chief offenders. Already the better class of fruit dealers are asking that the lines be drawn more stringently.

Meat companies have been required to wrap all fresh meat being shipped into this district. Where town markets have been established, as in Haileybury, there is much need for a careful inspection of the methods of displaying and handling meat. The public must be prevented from mauling and handling these foods before they are sold. The shops are well screened and we have had little trouble keeping the meat in off the street. During the past year I have seized quantities of meat, (in Sudbury, Cochrane and Hearst) usually on station platforms. I am convinced that there should be a limit to the distance that meat may be shipped without refrigeration during summer.

Bread is exposed in many ways to contamination, in the bakery, during delivery, and in stores where it is kept for sale. The yeast is frequently soured by being kept too long and by being infected by acid-producing organisms. Troughs are of very open construction, the seams allowing the retention of stale dough. The floors are seldom found free from dust and dough; while the filthy habits of workmen such as tobacco smoking and chewing, as in Sudbury, North Bay and Cochrane, adds nothing to the production of clean food. That the spitting associated with these habits is filthy and most serious becomes the more evident when it is pointed out that one baker in North Bay was in an advanced stage of consumption. It is not uncommon to find bread piled on these filthy floors. During delivery something should be done to prevent the hands of the driver from coming in contact with

the loaves. I have been advising the use of a pair of tongs. In stores where bread is kept for sale it is often exposed on the counter where it may be handled by customers. One sample of bread from Cochrane was sent to the Provincial Laboratory for analysis after having caused the serious illness of one who had eaten it. The bread was very sour and acid, this proved to be due to Lactic Acid and was undoubtedly caused by the yeast becoming infected with lactic acid bacilli. The sterilizing of the utensils and the use of new yeast was sufficient to correct the condition.

Slaughter-Houses.

Slaughter-houses were examined in all organized centres. A few township slaughter-houses which I have but recently become aware of were overlooked. These operate little if any in winter. Places where animals are slaughtered are in my district the most unsanitary places for the handling and preparing of food with which I have to deal. Because of the proximity to highways and streams, three of these buildings in Burk's Falls and Copper Cliff had to be closed until they could be removed to more suitable locations. Six proprietors had to be summoned into police court before they found it convenient to comply with orders. In not one case did I find conditions approaching what they should be. The usual slaughter-house is composed of a small, one or two roomed, building constructed of logs or rough lumber in such a way as to make a cover overhead and to obstruct the public gaze. It is so imperfectly built as to give ready access to flies, which gather in great numbers on the exposed offal and blood. The floor is of such open construction as to permit blood and refuse, as in Copper Cliff, to readily pass through. Not unusually this is three or four feet above the ground as in Burk's Falls and Parry Sound, and hogs are allowed to run underneath to consume the drippings. Where the floors are impervious it is customary to have a gutter draining outside into a trough where hogs may feed, or onto the surface of the ground. It is quite the common thing for hides to be stored and cured in the same room where the slaughtering is done; or in an adjoining room with a partial or open partition. These buildings are frequently located near or over a stream as in Burk's Falls; and it has not been unusual to find these waters used for domestic purposes farther down. In Hearst, Swastika and a number of construction camps the slaughtering was being done on the ground in the open. The offal and blood was imperfectly burned, or buried, or left exposed to the sun where dogs made frequent visits.

The local boards have been asked to rigidly inspect all slaughter-houses and to insist that the floors of the killing and cooling rooms be of some impervious material, drained and connected to some sub-surface disposal system; while the walls to the height of six feet from the floor should be of some non-absorbent material: and all woodwork except floors must be white-washed or painted. The walls and floors must then be kept strictly clean. In only one case (North Bay) did I find floors and floor drainage so constructed as to work efficiently and in this instance some of the killing was done out in the yard. I found the floor clean in one place (Sprucedale). Here the hogs' food was prepared in the next room, attracting the largest cloud of flies that I have yet seen about a slaughter-house. Pigs and other animals were allowed to come to the building walls in all cases. Blood and raw offal were being fed to pigs, in the larger proportion of instances. This caused me to pen up one hundred and fifty pigs in North Bay and force the

owners to feed them whole grain for six weeks before restrictions were removed. I am able to report general improvement although I know of none that have fulfilled all requirements.

Foreign Boarding Houses.

Foreign boarding houses have received a little more than their fair share of my time and are constantly demanding more than the local boards are able to spare. It is well to remember that the Scandinavians, Danes, French and German are not included in the unsanitary foreign population. The special causes of complaint are chiefly in regard to the overcrowding, ventilation, uncleanliness, drainage, garbage receptacles, care of yards, and outhouses. There is no doubt that the cause of the overcrowding is partly economic and partly racial affiliation. This is indicated by the fact that in Sudbury, North Bay, Cobalt, Porcupine and Cochrane, where this concentration is most evident, the overcrowding was for accommodation of the five and ten cent variety; that is bed, blankets, heat and cooking utensils are provided for five and ten cents a day. There was undoubtedly a superabundance of twenty-five cent accommodation. In Sudbury I found fifty Pollacks in each of three cellars; rental was from twenty-five to forty dollars a month. This proves that these places are run on commercial principles for mutual benefit, always at a profit. In order to prevent working a hardship on these people, it was necessary, because of the lack of cheap accommodation in this same town, to permit this overcrowding until spring. Hundreds of beds were then thrown out (these were principally double tier bunks) and an appropriate number of iron beds put in their places by order. This brought about a complete cure and some twelve new boarding houses were built during the next season (1913). It is hard for those who have not seen them to appreciate the depraved condition of these foreign people with regard to dirty houses and defective personal hygiene. Their bodies are dirty to the point of filthiness; while carious teeth, nits in hair, body lice, enlarged tonsils, adenoids, and defective vision, etc., are other evidences of their unsanitary life. The floors are black with dirt and in the spring and fall they are covered with mud. The men go into bed with their day-clothes and boots on. An explanation of the condition of the mattresses and grey blankets hardly seems necessary. Meats and other food are kept in a cubby-hole under the stair along with some old clothes and possibly the cat, as was the case in one place in Sudbury, while those going up and down cause a shower of dust upon the food. Two unsanitary and overcrowded places in North Bay were closed until put in passable condition. The question of ventilation is not the worst feature of these places; but it is not rare to find them overheated with the air saturated with moisture. Rooms where the air is continuously overheated and over moist, produce all the ill effects of the worst ventilation. Towns such as North Bay and Porcupine rarely pay sufficient attention to the drainage of their foreign quarters. The lack of this provision undoubtedly has connected with it the unsanitary yard and privy. I have made it a point to advise municipalities to extend and force sewer connections in foreign sections. Garbage and kitchen waste must be collected in proper receptacles and not thrown out on the ground as is the rule. In Sudbury, Cobalt, North Bay, Schumacher and Cochrane the yards are used in no small way as urinals; but not only that, the amount of fæcal matter lying around renders the filth of the places indescribable. Closets are of the pit variety; but the pits are of very small capacity and are never cleaned out during the winter months. The walls are very open and roofs are often absent. The construction is very suggestive of what

one might expect to find inside. The pits are filled beyond their capacity. Deposits of fæcal matter are found on the seats and floors and about the yards. Such a state of affairs permits the discharges of the bowel and bladder to be carried into the houses on the shoes, and in this way adds to the dangers of the unclean house.

My observations in the towns mentioned where the foreign population is a factor, have led me to believe that the unsanitary conditions incident thereto cannot be improved by hygenic argument. The cure lies in providing sewers to these quarters, by forcing connection, and then by an educational campaign of strict enforcement of the Health Act. The reward to be obtained by making the police court the dynamics of this Act is worthy of the effort required. Thirty-two police court cases were provided in one week in Sudbury, and in North Bay twenty in the same time. Cobalt has this question in hand better than any other town in my territory, due to the thorough health organization and to the energy of their past Medical Officer, Dr. Hair, and of their competent sanitary inspector.

I noticed that on contracts in North Bay portable closets were now being used, and I mention it here because it has to do chiefly with the foreigner. The Board of Health now insist that contractors provide a suitable number and that the strictest supervision be maintained in order to prevent nuisance.

Hotels and Restaurants.

I found it necessary to close one of the largest hostelries in North Bay because of filthy cellars, dirty kitchens and bad plumbing. This turned out to be an exceedingly good move and stimulated all the hotels in my district toward improved conditions. All hotels were advised to supply lavatories with paper towels, and to remove common drinking glasses. A glass in each bed-room was suggested to supply this need. The method of washing dishes is a matter requiring careful supervision. Glasses used in the dining-room are cleaned by simply throwing out the water and wiping them dry with a dirty towel. This is a fruitful method of spreading disease. Plumbing, ventilation of kitchens, screening, disposal of garbage, etc., have been causes of complaint in North Bay, Sudbury, Depot Harbor, Scotia Junction, Chelmsford, South Porcupine, Golden City, Timmins New Liskeard and Haileybury.

One restaurant was closed because the owner of the building refused permission to make such structural changes as were necessary to put the place in condition from a sanitary point of view.

This brief resume of the first year's work in District No. 6 I have the honour to respectfully submit.

DISTRICT NO. 7.

Comprising districts of Algoma, Kenora, Manitoulin, Rainy River and Thunder Bay.

R. E. Wodehouse, M.D.,

District Officer of Health, Port Arthur.

I beg to submit the following report of the work accomplished in district No. 7 since October, 1912. Permit me to say that the organization of the health work under the district officers appears to be very popular with the municipalities, both organized and unorganized. The number of appeals for active help as well as advice in matters of health organization and equipment is exceedingly large.

Actual work from district headquarters began November 10, 1912, and from that date till December 31, 1912, 2,691 miles were travelled, visits being made to Ft. Frances, Nepigon, Schreiber, Sault Ste. Marie, Rainy River, Emo and Ft. Frances a second time; the total cost being $140.70, exclusive of transportation.

The mileage travelled between January 1 and December 31, 1913, was 35,552 miles, at a cost of $1,237.50, exclusive of transportation. Official visits were made to the number of 120, to 49 different centers of population.

Infectious diseases were investigated as follows:

Smallpox at Manitowaning, Manitoulin Island, and at Little Current. Indians were the only people infected. The M.O.H. of Manitowaning very effectively vaccinated the white residents of his town without proclamation. At my request extra sanitary police were employed as well as a full time doctor to look after the epidemic at the expense of the Dominion Indian Department.

At Little Current only three isolated cases appeared, some time apart. Both localities were infected from an outbreak at Collins Inlet.

At Dorion (unorganized) one house contained two cases and four other houses were quarantined, and over 100 people were vaccinated. Source of contact not known.

At Rosslyn, in Paipoonge Township, one brick establishment and finally five houses were infected. One case developed in brick works and was removed. At end of detention period of fourteen days a man having aches and discomfort was liberated along with other hands and quarantine lifted. This sick man developed smallpox and was not quarantined for a week after appearance of rash, hence five other homes were infected.

At Emo, more correctly Barwick, a series of cases numbering eighteen, spread over three months, caused considerable worry, the first case, undetected, being the only practising barber in the village. Over 800 people were vaccinated voluntarily, and at the request of the Board international quarantine was established locally against Minnesota in the United States.

At Rainy River an undiagnosed case gave rise to a case in a nurse who returned to Winnipeg before developing it. A second case developed in the Rainy River Home.

Chicken-pox at Keewatin was effectively handled pending the diagnosis of the District Officer. Strict quarantine and energetic personal investigation of unreported cases by the medical officer of health were worthy of note.

Scarlet fever, at Schreiber, appeared suddenly in several families of railway employees. The members of train crews drawing from $175.00 a month to $250.00, failed to call in a doctor in some cases, fearing quarantine of wage earner; result, an epidemic, small in size, developed.

At Nepigon two or three cases completed scaling before the municipality learned of them and called your officer in.

Scarlet Fever at Ignace; one case demanded my attention, owing to other railway employees feeling that an inefficient quarantine was being maintained.

At Keewatin a small epidemic gained headway during the temporary absence of the Medical Officer of Health from the town, but which, by rigid administration, upon his return, was soon stamped out.

Diphtheria at Sault Ste. Marie had been epidemic for three or more years and again this year. It was wiped out by generous publicity and education of the public, provision of free antitoxin, examination by culture of school children for detection of carriers and the opening of an Isolation Hospital, under the direction of your officer.

At Rainy River a considerable epidemic, resulting in two deaths, developed. It was effectively handled by the Medical Officer of Health, your officer being deprived of the privilege of co-operating, owing to Health Lecture course being in progress.

Typhoid Fever at Pt. Arthur and Sault Ste. Marie. The prevalence of this disease was investigated minutely, much to the detriment of the health index of both communities and of the employees of the Algoma steel works. The public water supply in all three cases was found to be constantly polluted Chlorination of the city supplies was instituted upon my order, and in both cities the dosage administration was very unsatisfactory. Efficient results in each city were obtained by way of reduced case incidence. The steel works were ordered to provide pure water for employees and to have the contaminated supply used mechanically throughout the works made unavailable for drinking purposes by the employees.

Complete sanitary surveys were made of the twenty-eight organized municipalities in this district and inspections were made of four summer resorts. These surveys are reported, accompanied with copies of all health by-laws, water tariffs, maps of water and sewer utilities, with number of services and are on file in duplicate at the Toronto and Ft. William offices.

Three of the municipalities are cities, namely Ft. William, Pt. Arthur and Sault Ste. Marie, having populations respectively of 23,000, 15,654 and 12,500 (from assessor's roll). Each maintains a full time sanitary inspector. Pt. Arthur has a full time medical officer of health and Ft. William a full time health visiting nurse, and all three have efficient Isolation Hospitals.

Two of the municipalities have 6,000 inhabitants each, namely Kenora and Steelton, Kenora maintaining a full time sanitary inspector.

A general water supply is provided in all the aforementioned places and in the following as well, Rainy River, Ft. Frances, Nepigon, Schreiber, White River, Massey and Thessalon. The supplies of Ft. William, Nepigon, Schreiber and White River come from inland lakes, the catchment areas of which are uninhabited, and water purity unquestionable. Chlorination of water has been instituted upon order of the Board, during the year at Pt. Arthur, Sault Ste. Marie, Steelton, Kenora, Rainy River and Ft. Frances. It has also been instituted at three hotels at Little Current, one at Silver Islet and at summer resorts at Loon Lake and at Lake of the Woods.

All these municipalities have constructed sanitary sewers except Massey. The sewer construction in each municipality is usually 100 per cent. in excess of that utilized, or in other words only about 50 per cent. of the buildings abutting on sewers are connected for service. Rainy River, Pt. Arthur, Nepigon, Schreiber, White River and the Thunder Bay Industrial Farm have undertaken treatment of sewage, all as a result of orders issued by the Board.

Ft. William is the only municipality possessing privies uniform in structure in accordance with a by-law. They are of the dry variety, can type, with flap board at rear for removal of cans. They are maintained in a most disgusting state, so far as flies are concerned. All the other municipalities possess privies of every variety and condition.

Ft. William has an incinerator under construction.

Vital statistics are almost useless except in Ft. William, this being the only place where they are studied and tabulated. Pt. Arthur will soon have, thanks to the municipal clerk, complete records for years back, available for possible reference and study.

The milk industry of this entire district possesses one sterilizing plant, this one being maintained by the Model Dairy at Sault Ste. Marie. Outside of combating infectious diseases after they have made their appearance in epidemic form, the Board of Health efforts in all the communities, except the cities, are confined to feeble attempts to regulate the milk supply.

Disgustingly dirty slaughter-houses were improved, upon order from this department, at Little Current, Gore Bay, Massey, Blind River and Thessalon. The price of meat is lower and the quality of same is much higher in the places supplied with meat from these slaughter-houses than in those centres dependent upon cold storage supply. Especially is this evident in Thessalon, where a cold storage firm maintains a retail store. They had to establish a local place of killing and provide fresh dressed meat to maintain their retail business.

School buildings in this district generally speaking are new, modern in structure, ventilation, heating and lighting, are cleanly kept and satisfactory except for common drinking cups being maintained in most cases.

All health officers in the organized municipalities are receiving remuneration in excess of the minimum basis of $100.00 for the first 1,000 population and $50.00 a thousand after. They are each and every one young aggressive men, and with few exceptions are sincerely interested in the work. The Medical Officer of Health at Pt. Arthur is personally responsible for the medical inspection of the schools (public), as is also the Medical Officer of Health at Steelton. Sault Ste. Marie has a separate school medical officer. Ft. William's health nurse spends her mornings at school work.

Transportation lines have been closely watched and unsanitary terminals or places on their right of way have been immediately rectified by the officials when notified. The purity of the water supplied the men and public for drinking purposes has been investigated and recommendations for its improvement made.

As a result of the year's work, along with a course of lectures given in which Dr. Geo. Porter and Dr. Helen MacMurchy kindly granted valuable assistance, conditions are decidedly improved. Many offenders are indignant at the arrogant interference of the Provincial Board of Health. Conditions as they exist are better known to the Toronto office. Each day brings fresh requests for advice and co-operation from railways and municipalities and, in a word—"the service is popular."

APPENDIX.

Provincial Board of Health Sanitary Investigation.

The line of investigation pursued by the District Officers is as follows:—

Municipality? County of? Population? Character of? Date?

Health Organization.

Local Board of Health? Medical Officer of Health? Pay? Sanitary Inspector? Pay? Number and names of physicians? veterinary surgeons, undertakers?

Vital Statistics.

See Division Registrar.

Public Institutions.

Hospitals? gaols? houses of refuge? public or private sanatoria? maternity homes or hospitals? superintendent? Number and character of buildings? Number of inmates? Number of beds? Nurses? Help (convalescents used?) Licenses? Do inmates in gaols and houses of refuge do any work? Area of land? What produced? Provision for tuberculosis cases? Provision for communicable diseases? Care of excreta? Sewage and sewage disposal? Manure, garbage and dressing disposal? Water supply? screens? Milk supply? Hog pens? Refuse used as hog and chicken food? How conducted, well or otherwise? Do they report cases and deaths? Laboratory facilities? Vaccine kept? Cost of maintenance?

Municipal laboratories? How manned? Work done? Number of specimens? Cost of maintenance? Is laboratory used for food and milk?

Water Supply.

Municipal supply? Private wells? Fire supply?

(1) If *private* wells what general care taken? Depth? Are houses close together? Character of soil from top to bottom? Depth of water in wells in general? Do they go dry at any time? Is there any special odor of water? or taste? or color? Any complaint about hardness, etc.? Age of well? Number of users?

(2) *Municipal Supply*: Public or private ownership? source? deep well? spring? stream? river or lake? Possibility of infection? Possibility of extension? Care taken to protect catchment area? Population on? etc. Quantity per head provided? Number of users? Meters? or flat rate? or both? Cost of users? Distance? First town above source? Any treatment? How long applied? Cost? Cost of distribution system? Efficiency of management? Supervision? General feeling regarding supply? Number of manufacturers using water in a special way? Typhoid death rate? Investigation carefully made? Prevalence of intestinal diseases? Water by-law.

(3) Is there a fire system? General Cost? Maintenance per year? Number of employees? Voluntary or paid? Skilled? or otherwise? Any auxiliary municipal fire supply which might foul the domestic supply? Factory supply? Enquire number of balance valves?

Food Supply.

Milk, quality, flavours? Price summer? winter? Number of producers? Inspected? Number of dealers licensed or otherwise? Source? Distance? Number of deliveries daily? Sunday delivery? By-law? License? Requirements of by-law as to solids, fat, temperature, tuberculin test, bacterial count? inspection—veterinary or lay? Milk certified pasteurized (flask or holder) untreated? certified? General character of milk supplied? Care taken by producers and dealers? Is loose milk sold? General feeling as to whether preservatives used or not? Do groceries sell milk? How many local small producers?

Meat.

Inspectors? Number of dealers? wholesale? retail? Meat packing establishments? Inspected by Dominion or by local authority? Municipal abattoir? Market sale? Inspection? Price of meat—wholesale? retail? winter? How much supplied by large wholesalers? Method of refrigeration? Method of poultry preservation? Care as to food? supplies, meat, bread, fish, fruit, etc. Any screening of shops? Any other observation *re* foods, especially meat, fish and fruit.

Sewerage.

Is there a town engineer? giving all his time? qualification? Staff? Is there a sewage commission? (and water)?

(1) Is there a sewerage system? Extent and character of? Separate or combined? Is it part of general plan? Situation of outfalls (if possible, with map)? Can outfalls be connected with trunk sewer? or otherwise? Plumbing by-law? Number of house services? Who looks after them? Factories using sewers? Character of factories? tanneries? etc. Character of waste? Quantities discharged from each factory? Is there preliminary treatment? Character of this treatment? Total quantity of sewage? Any complaint? Any treatment? Efficiency of same? Character and efficiency of management? Number of men looking after treatment?

(2) *Night soil*: How collected? Private? or municipal? Frequency? disposal of? character of privies? Estimated number? Pits? Dry earth? cleanliness? Ventilated? Screened against vermin and flies? by-law?

Garbage.

Collection and disposal of ashes, rags, paper, cans, house refuse. Any by-laws? Locality and condition of dumps? Destructor or incinerator?

Condition of Streets.

Paved? miles? character? unpaved? miles? character? Cleaning? how? Disposal of cleanings? Any oiling of streets?

Condition of Lanes.

Paved, miles? character? unpaved? miles? character? Cleaning? how? Disposal of cleanings? In planning for new sections of municipality are lanes abolished?

Vacant Lots.

Extent and condition?

Ponds, Lakes and Streams.

Number? Extent? Condition as to cleanliness? If possible daily flow from?

Schools.

Number, public? private? separate? high? character of building in each case? Number of pupils and teachers? Lighting? ventilation? heating? Fire escapes? Sanitary conveniences? Water supply? Medical inspection?

Ice Supplies.

Source? number of dealers? licensed or not? Sanitary conditions of source? General care taken? Number of users? How much used for cooling purposes? Care in distribution?

Railways.

Sanitary condition of station lavatories? trains? provision for any disinfection of cars? if so, what? Cattle yards? etc. Distribution of manure? Water supply in station? on trains? Lavatories? Nuisances caused by railway fillings, stagnant water?

Steam Boats.

Sanitary conditions? Lavatories? Disposal of excreta? Disposal of garbage? Water supply? Any history of typhoid? Kitchen? Dining-rooms?

Apartment houses.

Dark rooms in? General character of families? Children allowed in? Any yard space?

Restaurants and Hotels.

Sanitary condition, lavatories? Stables? Kitchens? Washing of vessels? dishes, glasses, etc. Screening?

Any history of epidemics and local diseases? Ergotism, human or animal? rabies? trembles? swamp poisonings? conium? etc.

General Remarks.

In all cases please be careful to make report under several headings in the order herein set out.

NAMES OF MEDICAL OFFICERS OF HEALTH AND SECRETARIES OF LOCAL BOARDS OF HEALTH FOR 1914.

ALGOMA.	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Blind River	W. S. Burd, Blind River	M. F. Dyke, Blind River.
Bruce Mines Tn.	A. P. Hart, Bruce Mines	Thos. Sullivan, Bruce Mines.
Chelmsford		
Day & Bright, Addl.	A. G. Wallis, Thessalon	Chas. Cavanagh, Sowerby.
Day & Mills Tp.		
Garden River		
Goulais Bay (unorganized)		A. McAuley, Goulais Bay.
Hilton	B. A. Blackwell, Richard's Ldg.	W. E. Whybourne, Marksville.
Jocelyn		H. Johnson, Kentvale.
Johnston	B. Walden, Desbarats	A. E. Osborne, Port Lock.
Korah	A. S. McCaig, Sault Ste. Marie	R. M. Moore, Sault Ste. Marie
Laird	G. H. L. Armstrong, Echo Bay	T. H. Schoales, Laird.
McDonald & Meredith	G. H. L. Armstrong, Echo Bay	W. L. Cherry, Sylvan Valley.
McMahon & Morin		
Massey Tn.	T. F. Flaherty, Massey	D. W. Cantlon, Massey.
Merit Tp.		
Michipicoten Rr.		
Missanabie		
Plummer, Addl.	A. P. Hart, Bruce Mines	
Plummer Tp.		
Prince Tp.	A. S. McCaig, Sault Ste. Marie	W. W. Wilson, Steelton.
St. Joseph Island	B. A. Blackwell, Richard's Ldg.	H. M. Ross, Richard's Ldg.
Sault Ste. Marie City	A. S. McCaig, Sault Ste. Marie	C. J. Pim, Sault Ste. Marie.
Steelton Tn.	J. W. Hunt, Steelton	J. Robinson, Steelton.
Tarbutt & Tarbutt Addl.	B. Walden, Desbarats	R. H. Barr, Maclennan.
Tarentorus & Rankin	A. S. McCaig, Sault Ste. Marie	B. R. McMullen, Sault Ste. Marie
Thessalon Tn.	A. G. Wallis, Thessalon	E. G. Scott, Thessalon.
Thessalon Tp.	A. G. Wallis, Thessalon	Thos. E. Clinton, Thessalon.
Victoria Tp.		
Wells & Wharncliff		
White River		
Wikwemikog		

BRANT.		
Brantford Tp.	C. D. Chapin, Brantford	Jas. A. Smith, Brantford.
Brantford City	F. G. E. Pearson, Brantford	H. F. Leonard, Brantford.
Burford Tp.	T. H. Johnston, Burford	F. W. Taylor, Burford.
Dumfries S.	J. L. Addison, St. George	H. S. Maus, Paris.
Oakland Tp.	T. H. Mott, Mohawk	Percy M. Button, Scotland.
Onondaga Tp.	H. Maw, Caledonia	Alfred Burril, Onondaga.
Paris Tn.	W. J. Logie, Paris	Thos. McCosh, Paris.

BRUCE.		
Albemarle Tp.	H. Wigle, Wiarton	Thos. Covenay, Purple Valley.
Amabel Tp.	F. Campbell, Hepworth	R. H. Murray, Allenford.
Arran Tp.	M. A. V. Armstrong, Tara	H. T. Potts, Tara.
Brant Tp.	Dr. Murray, Cargill	M. A. McCallum, Elmwood.
Bruce Tp.	J. D. Struthers, Tiverton	J. G. MacKay, Underwood.
Carrick Tp.	J. A. Wilson, Mildmay	J. A. Johnson, Mildmay.
Chesley Tn.	J. J. B. Downing, Chesley.	H. S. Sanderson, Chesley.
Culross Tp.	M. H. Gillies, Teeswater	Chas. Button, Teeswater.
Eastnor Tp.	Roy Hacking, Lion's Head	Edwin Brooks, Lion's Head.
Elderslie Tp.	P. J. Houston, Paisley	R. C. Pearse, Paisley.
Greenock Tp.	D. C. Murray, Cargill	Thos. H. Purdy, Narva.
Hepworth V.	F. Campbell, Hepworth	W. R. White, Hepworth.
Huron Tp.	D. A. McCrimmon, Ripley	Angus Martyn, Ripley.
Kincardine Tp.	Thos. Bradley, Bervie	H. A. Smith, Armow.
Kincardine Tn.	Jas. McDonald, Kincardine	J. H. Scougall, Kincardine.
Kinloss Tp.	David Jameson, Whitechurch	Thos. Murray, Langside.

BRUCE.—*Continued.*	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Lindsay Tp.	Roy Hacking, Lion's Head	Peter Currie, Cape Chin.
Lucknow V.	D. M. Gordon, Lucknow	J. A. Agnew, Lucknow.
Paisley V.	H. E. Gage, Paisley	J. C. Gibson, Paisley.
Port Elgin V.	F. H. Wells, Port Elgin	D. Geddes, Port Elgin.
St. Edmunds Tp.	Roy Hacking, Lion's Head	Lytle Spears, Tobermory.
Southampton Tn.	P. J. Scott, Southampton	J. C. Eckford, Southampton.
Saugeen Tp.	Geo. Veitch, Port Elgin	F. W. Elliott, Port Elgin.
Tara V.	J. McAsh, Tara	W. J. Taylor, Tara.
Teeswater V.	M. H. Gillies, Teeswater	John Farquhan, Teeswater.
Walkerton Tn.	R. T. Porter, Walkerton	J. H. Scott, Walkerton.
Wiarton Tn.	A. H. Haugh, Wiarton	J. H. Fielding, Wiarton.
Tiverton V.	J. D. Struthers, Tiverton	R. N. Blair, Tiverton.
CARLETON.		
East View V.	R. H. Parent, Ottawa	H. R. Washington, Cummings Bridge.
Fitzroy Tp.	W. B. McNaughton, Arnprior	A. Murphy, Antrim.
Gloucester Tp.	J. Fenton Argue, Ottawa	
Goulbourn Tp.	R. C. Chanonhouse, Richmond	J. Cummings, Hazeldean.
Gower N., Tp.	H. G. F. Blair, N. Gower	J. E. Craig, N. Gower.
Huntley Tp.	Osler M. Groves, Carp	Jas. H. Wilson, Carp.
Marlborough Tp.	H. G. F. Blair, N. Gower	Edward Mills, Malakoff.
March Tp.	G. H. Groves, Carp	Thos. Richardson, South March.
Nepean Tp.	Jas. S. Nelson, Westboro	John Gamble, Westboro.
Osgoode Tp.	C. Morrow, Metcalfe	F. Iveson, Metcalfe.
Ottawa City	T. A. Lomer, Ottawa	G. McClymont, Ottawa.
Richmond V.		
Tarbolton Tp.	O. M. Groves, Carp	D. B. McLaren, Dirleton.
DUFFERIN.		
Amaranth Tp.	G. J. Campbell, Grand Valley	E. Hamilton, Laurel.
Garafraxa E., Tp.	Allan Gibson, Hillsburg	John Preston, Marshville.
Grand Valley V.	W. H. McClelland, Grand Valley	J. A. Richardson, Grand Valley.
Luther E., Tp.	M. W. Berwick, Grand Valley	J. A. Richardson, Grand Valley.
Melancthon Tp.	T. J. Gowan, Horning's Mills	T. C. Dryden, Riverview.
Mono Tp.	T. A. Carson, Orangeville	W. A. Henry, Mono Centre.
Mulmur Tp.	G. C. McGibbon, Honeywood	Geo. Laking, Shelburne.
Orangeville Tn.	T. H. Henry, Orangeville	A. A. Hughson, Orangeville.
Shelburne V.	J. A. Smith, Shelburne	Thos. Whalley, Shelburne.
ELGIN.		
Aldborough Tp.	S. M. Dorland, Rodney	E. A. Hugill, Rodney.
Aylmer Tn.	F. F. McEwan, Aylmer	D. C. Davis, Aylmer.
Bayham Tp.	A. D. Naismith, Straffordville	Benj. Brian, Straffordville.
Dorchester S.		
Dunwich Tp.	W. H. McFarlane, Wallacetown	D. A. McNabb, Dutton.
Dutton V.	A. McKillop, Dutton	J. D. Blue, Dutton.
Malahide Tp.	J. D. Leeson, Aylmer	John M. Hale, Aylmer.
Port Stanley V.	G. H. Jackson, Union	J. S. Robertson, St. Thomas.
Rodney V.	J. M. Paterson, Rodney	J. D. Shaw, Rodney.
St. Thomas City	D. A. McKillop, St. Thomas	W. J. Shaw, St. Thomas.
Southwold Tp.	D. Smith, Fingal	J. C. McLennan, Fingal.
Springfield V.	L. H. Douglass, Springfield	J. B. Lucas, Springfield.
Vienna V.	H. Johnston, Port Burwell	Saml. S. Clutton, Vienna.
West Lorne V.	D. F. Webster, West Lorne	J. S. Robertson, St. Thomas.
Yarmouth Tp.	G. A. Shannon, St. Thomas	W. C. Caughill, St. Thomas.
ESSEX.		
Amherstburg Tn.	T. J. Park, Amherstburg	G. E. Pulford, Amherstburg.
Anderdon Tp.	W. F. Park, Amherstburg	A. C. Mailloux, Amherstburg.
Belle River V.	A. H. E. Trottier, Belle River	A. La Chante, Belle River.
Colchester N.	H. A. Bowrie, Essex	L. C. Hillis, Gesto.
Colchester S.	Dr. Collins, Harrow	J. H. Madill, Harrow.

Essex.—*Continued.*	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Essex Tn.	W. C. Doyle, Essex	R. R. Brett, Essex.
Gosfield N., Tp.	J. W. Brien, Essex	W. H. Noble, Cottam.
Gosfield S.	W. J. McKenzie, Kingsville	G. W. Coatsworth, Kingsville.
Kingsville Tn.	J. E. Jenner, Kingsville	Geo. Pearse, Kingsville.
Leamington Tn.	C. N. Anderson, Leamington	R. M. Selkirk, Leamington.
Maidstone Tp.	S. F. Millen, S. Woodslee	W. R. Phillips, Maidstone.
Malden Tp.	O. Teeter, Amherstburg	E. H. Bratt, Malden Centre.
Mersea Tp.	Jas. King, Leamington	A. Hairsine, Leamington.
Ojibway Tn.	J. W. Brien, Essex	John Moynahan, Windsor.
Pelee Island Tp.	J. A. Roy, Pelee Island	Wm. Stewart, Pelee Island.
Rochester Tp.	S. F. Millen, S. Woodslee	M. N. Mousseau, S. Woodslee.
Sandwich E., Tp.	P. Poisson, Tecumseh	Louis Laramie, Tecumseh.
Sandwich S., Tp.	J. W. Brien, Essex	John McAuliffe, Maidstone.
Sandwich W., Tp.	U. J. Durocher, Windsor	Ernest Bondy, Canard River.
Tilbury W., Tp.	C. E. Knister, Comber	S. T. Anderson, Comber.
Tilbury N., Tp.	M. Sharp, Tilbury	J. A. Tremblay, Tilbury.
Sandwich Tn.	W. J. Beasley, Sandwich	E. R. North, Sandwich.
Walkerville Tn.	G. Little, Walkerville	
Windsor City	G. R. Cruickshank, Windsor	Stephen Lusted, Windsor.

Frontenac.

Barrie Tp.	T. J. C. Tindle, Flinton	W. P. Maynard, Cloyne.
Bedford Tp.	G. H. Berry, Westport	Jas. McNeil, Burridge.
Clarendon & Miller Tp.	C. Parsons, Ardoch	J. F. Card, Plevna.
Garden Island Tp.	R. W. Garrett, Kingston	B. H. Williams, Garden Island.
Hinchinbrooke Tp.	H. R. Barker, Parham	Geo. A. Smith, Parham.
Howe Island Tp.	— O'Connor, Gananoque	
Kennebec Tp.	W. Kilborn, Sharbot Lake	D. A. Osborne, Arden.
Kingston City	A. R. B. Williamson, Kingston	W. W. Sands, Kingston.
Kingston Tp.	E. W. Wilkins, Harrowsmith	Chas. Adair, Cataraqui.
Loughborough Tp.	M. Tovell, Sydenham	F. M. Lawson, Sydenham.
Olden Tp.	H. R. Barker, Parham	W. P. Bender, Long Lake.
Oso Tp.		Bertram Smith, Sharbot Lake.
Palmerston Tp.		Jas. Geddes, Snow Road.
Pittsburg Tp.	C. A. Morrison, Kingston	Wm. Murray, Barriefield.
Portland Tp.	W. J. Geddes, Verona	T. A. Kerr, Harrowsmith.
Portsmouth V.	Wm. Gibson, Kingston	J. W. Henstridge, Portsmouth.
Storrington Tp.		
Wolfe Island Tp.	W. A. McCarthy, Kingston	D. J. Dawson, Kingston.

Grey.

Artemesia Tp.	T. Carter, Flesherton	W. J. Bellamy, Flesherton.
Bentinck Tp.	J. L. Smith, Dornock	J. W. Chittick, Lamlash.
Collingwood Tp.	Frank Moore, Clarksburg	Edw. Rorke, Thornbury.
Chatsworth V.	T. McCullough, Chatsworth	W. G. Reilly, Chatsworth.
Derby Tp.	A. B. Rutherford, Owen Sound	W. H. Hilts, Kilsyth.
Dundalk V.	F. Macliss, Dundalk	M. W. Ridley, Dundalk.
Durham Tn.		
Egremont Tp.	F. H. Sneath, Dromore	David Allan, Holstein.
Euphrasia Tp.	— Miller, Rocklyn	N. L. Curry, Rocklyn.
Glenelg Tp.	J. G. Hutton, Durham	J. S. Black, Priceville.
Holland Tp	J. H. Bull, Holland Centre	J. P. Hare, Holland Centre.
Hanover Tn.	E. T. Eede, Hanover	John Taylor, Hanover.
Keppel Tp.	H. R. Hay, Wiarton	Geo. Atkey, Wiarton.
Markdale V.	A. Brown, Markdale	W. J. Shortell, Markdale.
Meaford Tn.	Jos. Jordan, Meaford	Geo. Albery, Meaford.
Neustadt V.	W. M. Brown, Neustadt	R. W. Walden, Neustadt.
Normanby Tp.	J. L. Easton, Ayton	R. H. Fortune, Ayton.
Osprey Tp.	A. H. McFadden, Singhampton	Thos. Scott, McIntyre.
Owen Sound Tn.	H. G. Murray, Owen Sound	Chas. Gordon, Owen Sound.
Proton Tp.	F. Martin, Dundalk	Thos. Laughlin, Dundalk.
St. Vincent Tp.	J. G. Clarke, Meaford	Geo. G. Albery, Meaford.
Sarawak Tp.	W. T. Frizzell, Owen Sound	Wm. Morton, East Linton.
Shallow Lake Tp.	D. E. Howes, Shallow Lake	Robt. E. Young, Shallow Lake.
Sullivan Tp.	E. Oldham, Chatsworth	Alex. Stephen, Marmion.
Sydenham Tp.	Wm. McDonald, Annan	J. M. Thomson, Bognor.
Thornbury V.	Saml. McCallum, Thornbury	Edward Rorke, Thornbury.

Haldimand.	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Caledonia V.	H. Maw, Caledonia	J. W. Avery, Caledonia.
Canborough Tp.	Dr. Yelland, Dunnville	M. E. Shaver, Canboro.
Cayuga N. Tp.	E. T. Snider, Cayuga	W. Teasdale, Cayuga.
Cayuga S., Tp.	Dr. Alexander, Dunnville	Jas. Caughell, S. Cayuga.
Cayuga V.	E. T. Snider, Cayuga	J. W. Sheppard, Cayuga.
Dunn Tp.	N. Hopkins, Dunnville	O. Dickhaut, Byng.
Dunnville Tn.	N. Hopkins, Dunnville	J. W. Holmes, Dunnville.
Hagersville V.	R. McDonald, Hagersville	J. T. Park, Hagersville.
Jarvis V.	O. J. Newell, Jarvis	A. Rodgers, Jarvis.
Moulton Tp.		
Oneida Tp.	H. Maw, Caledonia	John Senn, Caledonia.
Rainham Tp.	J. B. Widdis, Fisherville	L. F. Culver, Rainham.
Seneca Tp.	F. G. Morrow, Caledonia	N. H. Wickett, York.
Sherbrooke Tp.	N. Hopkins, Dunnville	L. McCallum, Stromness.
Walpole Tp.	W. Jaques, Jarvis	S. A. Thompson, Nanticoke.

Haliburton.		
Anson & Hindon Tp.	O. A. Pogue, Minden	Wm. A. Welch, Minden.
Cardiff Tp.	A. T. Embury, Bancroft	A. G. Tate, Highland Grove.
Dysart Tp.	E. S. Baker, Haliburton	G. H. Potts, Haliburton.
Glamorgan Tp.	R. S. Frost, Kinmount	J. A. Hargreave, Gooderham.
Lutterworth Tp.	E. A. White, Kinmount	John W. Hulby, Minden.
Minden Tp.	G. H. Bowen, Minden	E. A. Rogers, Minden.
Monmouth Tp.	L. Sheppard, Wilberforce	John Moore, Wilberforce.
Sherbourne Tp.		
Snowdon Tp.	G. H. Bowen, Minden	A. J. Scott, Gelert.
Stanhope Tp.	O. A. Pogue, Minden	Wm. Cooper, Boskung.

Halton.		
Acton V.	E. D. Ault, Acton	A. J. McKinnon, Acton.
Burlington V.	A. H. Speers, Burlington	Jas. S. Allen, Burlington.
Esquesing Tp.	J. R. Nixon, Esquesing	J. A. Tracy, Esquesing.
Georgetown V.	Jas. McAndrew, Georgetown	H. W. Kennedy, Georgetown.
Milton Tn.	R. K. Anderson, Milton	G. A. Hemstreet, Milton.
Nassagaweya Tp.	G. B. Carbert, Campbellville	John Marshall, Campbellville.
Nelson Tp.	A. C. Jones, Kilbride	J. F. Richardson, Milton.
Oakville Tn.	J. H. Stead, Oakville	W. Crawley, Oakville.
Trafalgar Tp.	Dr. Wilkinson, Palermo	Chas. Hall, Trafalgar.

Hastings.		
Bancroft V.		
Belleville City	H. A. Yeomans, Belleville	W. J. Thomson, Belleville.
Bangor *et al.*	F. R. Nicolle, Maynooth	John Perry, Maynooth.
Carlaw Tp.	J. L. Poirier, Craigmont	J. E. Greaves, Fort Stewart.
Deseronto Tn.	E. D. Vandervoort, Deseronto	H. R. Bedford, Deseronto.
Dungannon Tp.	A. T. Embury, Bancroft	John Lumb, L'Amable.
Elzevir and Grimsthorpe	A. R. Farrell, Tweed	W. J. Rhodes, Queensboro.
Faraday Tp.	A. T. Embury, Bancroft	W. A. Davy, Bancroft.
Hungerford Tp.	J. G. Burrows, Marlbank	Geo. H. Stokes, Tweed.
Huntingdon Tp.	E. D. Harrison, Madoc	D. L. Fleming, Ivanhoe.
Limerick Tp.	G. H. Gardiner, Eldorado	B. W. Welbar, Steenburg.
Madoc V.	W. A. Dafoe, Madoc	W. J. Hill, Madoc.
Madoc Tp.	W. A. Dafoe, Madoc	Wm. T. Allen, Madoc.
Marmora V.	H. Crawford, Marmora	H. W. Sabine, Marmora.
Marmora & Lake	D. Thompson, Marmora	Chas. Jones, Marmora.
Mayo Tp.	A. T. Embury, Bancroft	Jas. Douglass, Rowland.
Monteagle & Herschel	F. R. Nicolle, Maynooth	G. A. Jordison, Maynooth.
Rawdon Tp.	Jas. McC. Potts, Stirling	W. F. Bateman, Spring Brook.
Sidney Tp.	H. V. Malone, Frankford	A. M. Chapman, Belleville.
Stirling V.	Jas. McC. Potts, Stirling	G. H. Leury, Stirling.
Thurlow Tp.	D. W. and J. A. Faulkner, Foxboro	C. A. Callery, Canifton.
Trenton Tn.	W. B. Crowe, Trenton	G. W. Ostrom, Trenton.
Tudor & Cashel	G. H. Gardiner, Eldorado	Wm. Glennie, Millbridge.
Tweed V.	A. R. Farrell, Tweed	W. W. Garrett, Tweed.
Tyendinaga Tp.	H. O. Lanfear, Melrose	P. Shaughnessy, Melrose.
Wollaston Tp.		Alex. Miller, Coe Hill.

Huron.	M. O. H. and P.O. Address.	Secretary and P.O. Address.
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Bayfield V.	N. W. Woods, Bayfield	H. W. Erwin, Bayfield.
Blyth V.	W. J. Milne, Blyth	A. Elder, Blyth.
Brussels V.	T. T. McRae, Brussels	T. S. Scott, Brussels.
Clinton Tn.	J. W. Shaw, Clinton	D. L. McPherson, Clinton.
Colborne Tp.	B. C. Weir, Auburn	R. McIlwain, Nile.
Exeter V.	A. Quackenbush, Exeter	T. B. Carling, Exeter.
Goderich Tp.	J. B. Whitely, Goderich	N. W. Trewartha, Holmesville.
Goderich Tn.	A. C. Hunter, Goderich	L. L. Knox, Goderich.
Grey, Tp.	M. Ferguson, Ethel	A. H. Macdonald, Ethel.
Hay Tp.	A. J. McKinnon, Zurich	Fred. Hess, Sr., Zurich.
Hensall V.	Jas. McDiarmid, Hensall	A. Murdock, Hensall.
Howick Tp.	L. N. Whitely, Gorrie	G. W. Walker, Gorrie.
Hullett Tp.	D. Allison, Londesboro	Jas. Campbell, Londesboro.
McKillop Tp.	F. J. Burrows, Seaforth	M. Murdie, Winthrop.
Morris Tp.	R. Stewart, Belgrave	A. McEwen, Bluevale.
Seaforth Tn.	J. G. Scott, Seaforth	John A. Wilson, Seaforth.
Stanley Tp.	J. Rogers, Brucefield	R. J. Richardson, Varna.
Stephen Tp.	J. W. Orme, Crediton	Henry Eilber, Crediton.
Tuckersmith Tp.	J. G. Scott, Seaforth	D. F. McGregor, Seaforth.
Turnberry Tp.	R. C. Redmond, Wingham	Paul Powell, Wingham.
Usborne Tp.	H. K. Hyndman, Exeter	Francis Morley, Granton.
Wawanosh E., Tp.	R. L. Stewart, Belgrave	Alex. Porterfield, Belgrave.
Wawanosh W.	T. E. Case, Dungannon	W. A. Wilson, Lucknow.
Wroxeter Tp.	G. P. Jackson, Wroxeter	J. Brithaner, Wroxeter.
Wingham Tn.	R. C. Redmond, Wingham	John F. Groves, Wingham.

Kenora.		
Dryden	H. L. Blair, Dryden	Ira J. Wilde, Dryden.
Gold Rock		
Jaffrey & Melick	A. H. Edmison, Kenora	C. W. Belyea, Kenora.
Keewatin Tn.	E. Baker, Keewatin	W. J. Craig, Keewatin.
Kenora Tn.	A. D. Ferguson, Kenora	G. C. Hay, Kenora.
Machin Tp.	D. G. Dingwall, Dryden	W. W. Howell, Minnitaki.
Van Horne Tp.	D. G. Dingwall, Dryden	Thos. Marshall, Dryden.
Wagbiooon Tp.		

Kent.		
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Bothwell Tn.	A. D. Graham, Bothwell	W. H. Bradley, Botnwell.
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Chatham Tp.	C. R. Charteris, Chatham	A. M. C. Arthur, Tupperville.
Camden Tp.	H. S. McDonald, Dresden	M. S. Blackburn, Dresden.
Dover Tp.	W. R. Hall, Chatham	John Welsh, Chatham.
Dresden Tn.	J. I. Wiley, Dresden	J. T. Bridgwater, Dresden.
Harwich Tp.	A. R. Hanks, Blenheim	G. W. Riseborough, Blenheim.
Howard Tp.	P. B. Robertson, Ridgetown	Geo. McDonald, Ridgetown.
Raleigh Tp.	F. J. Reid, Merlin	A. E. Robinson, Charing Cross.
Romney Tp.	F. J. Walker, Wheatley	J. W. Kennedy, Wheatley.
Ridgetown Tn.	E. D. Gillies, Ridgetown	D. Cochrane, Ridgetown.
Tilbury E., Tp.	M. Sharp, Tilbury	A. Farquharson, R.R. 1, Merlin.
Tilbury Tn.	T. H. McCall, Tilbury	W. A. Hutton, Tilbury.
Thamesville V.	S. Stewart, Thamesville	W. J. Cryderman, Thamesville.
Wallaceburg Tn.	Geo. Mitchell, Wallaceburg	H. E. Johnson, Wallaceburg.
Zone Tp.	A. D. Graham, Bothwell	Geo. Bedford, Bothwell.

Lambton.		
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Arkona V.	E. M. Copeland, Arkona	J. Geo. Brown, Arkona.
Brooke Tp.	J. B. Martyn, Alvinston	W. G. Willoughby, Watford.
Bosanquet Tp.	A. J. Grant, Thedford	Geo. Sutherland, Thedford.
Courtright V.	J. Ferguson, Courtright	
Dawn Tp.	A. P. Chalmers, Oil Springs	J. M. Webster, Rutherford.
Enniskillen Tp.	F. W. Pirritts, Coplestone	Geo. V. Vyant, Petrolia,
Euphemia Tp.	W. A. Kelly, Florence	

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Moore Tp.	F. R. Seager, Brigden	C. C. Watson, Brigden.
Oil Springs V.	A. P. Chalmers, Oil Springs	D. P. Sisk, Oil Springs.
Plympton Tp.	P. McG. Brown, Camlachie	Thos. Nisbet, Wyoming.
Point Edward V.	A. N. Hayes, Sarnia	David Suhler, Pt. Edward.
Petrolia Tn.	R. S. McAlpine, Petrolia	J. McHattie, Petrolia.
Sarnia Tn.	A. C. Poussette, Sarnia	Jas. D. Stewart, Sarnia.
Sarnia Tp.	R. G. McDonald, Sarnia	Miles Carrick, Sarnia.
Sombra Tp.	W. J. Hicks, Wilkesport	W. A. Scott, Wilkesport.
Thedford V.	Harvey S. Clarke, Thedford	Wm. Brooks, Thedford.
Warwick Tp.	T. A. Brandon, Watford	N. Herbert, Watford.
Watford Tp.	R. G. C. Kelly, Watford	J. D. Brown, Watford.
Wyoming V.	W. Reid, Wyoming	H. G. Taylor, Wyoming.

LANARK.

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Bathurst Tp.	A. E. Hanna, Perth	R. M. Anderson, Perth.
Beckwith Tp.	J. A. McEwen, Carleton Place	J. W. Robertson, Carleton Place.
Burgess Tp.	A. W. Dwyre, Perth	R. T. Noonan, Stanleyville.
Carleton Place Tn.	J. M. Sinclair, Carleton Place	A. R. G. Peden, Carleton Place.
Dalhousie & Sherbrooke N., Tp.	A. Downing, Lanark	Walter Geddes, Dalhousie Lake.
Darling Tp.	L. V. Croft, Middleville	Thos. D. King, Tatlock.
Drummond Tp.	A. E. Hanna, Perth	E. R. Stedman, Perth.
Elmsley N., Tp.	A. E. Hanna, Perth	Roy Darou, Perth.
Lanark Tp.	L. V. Croft, Middleville	Arch. Rankin, Middleville.
Lavant Tp.	L. V. Croft, Middleville	Wm. Browning, Lavant Station.
Lanark V.	A. Downing, Lanark	R. Beatty, Lanark.
Montague Tp.	J. Connerty, Smith's Falls	
Pakenham Tp.	E. W. Gemmill, Pakenham	Jas. Connery, Pakenham.
Perth Tn.	A. W. Dwyre, Perth	J. A. Kerr, Perth.
Ramsay Tp.	A. A. Metcalfe, Almonte	T. A. Thompson, Almonte.
Sherbrooke S., Tp.	W. Kilborn, Sharbot Lake	H. J. Buchanan, Maberly.
Smith's Falls Tn.	C. L. Easton, Smith's Falls	Jas. A. Lewis, Smith's Falls.

LEEDS & GRENVILLE.

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Bastard & Burgess	J. M. Kelly, Delta	W. J. Birch, Delta.
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Crosby N., Tp.	Geo. H. Berry, Westport	Wm. McKnight, Westport.
Crosby S., Tp.	A. Coon, Elgin	J. R. Dargavel, Elgin.
Cardinal V.	J. A. Locke, Cardinal	M. Kavanagh, Cardinal.
Elizabethtown Tp.	A. H. Judson, Lyn	J. S. Webster, Bellamy's.
Elmsley S., Tp.	C. L. B. Stammers, Smith's Falls	John Rabb, Lombardy.
Escott Front, Tp.	J. M. Shaw, Lansdowne	F. T. Hutchison, Mallorytown.
Edwardsburg Tp.	P. A. McIntosh, Spencerville	M. McGuire, Spencerville.
Gananoque Tn.	J. P. Sinclair, Gananoque	S. McCammon, Gananoque.
Gower S., Tp.	F. L. S. Holmes, Kemptville	Elijah Pelton, Kemptville.
Kemptville V.	F. L. S. Holmes, Kemptville	S. H. Guest, Kemptville.
Kitley Tp.	W. H. Bourns, Frankville	J. M. Edgar, Toledo.
F. Leeds & Lansdowne	J. M. Shaw, Lansdowne	J. D. W. Darling, Lansdowne.
Rear of Leeds & Lansdowne Tp.	G. Belfie, Seeley's Bay	R. J. Green, Soperton.
Merrickville V.	M. J. O. Walker, Merrickville	D. J. Hall, Merrickville.
Newboro V.	R. B. King, Newboro	W. S. Bilton, Newboro.
Oxford-on-Rideau Tp.		
Prescott Tn.	C. F. McPherson, Prescott	Geo. Rook, Prescott.
Westport V.	C. A. Howard, Westport	W. S. Ripley, Westport.
Wolford Tp.	W. J. Anderson, Jasper	Geo. W. Harris, Jasper.
Yonge Front, Tp.	A. H. Judson, Mallorytown	F. H. Mallory, Mallorytown.
Yonge & Escott R., Tp.	J. F. Harte, Athens	R. E. Cornell, Athens.

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Amherst Island Tp.	Geo. Patterson, Odessa	W. H. Montray, Stella.
Bath V.		E. P. Sheppard, Bath.
Camden E., Tp.	J. H. Oldham, Yarker	T. E. McGill, Centreville.
Denbigh, Abinger & Ashby Tp.	Jos. Adams, Denbigh	Paul Stein, Denbigh.
Ernestown Tp.	J. E. Maybee, Odessa	E. O. Clarke, Odessa.
Fredericksburg N., Tp.	T. W. Simpson, Napanee	M. A. Sills, Napanee.
Fredericksburg S., Tp.	H. S. Northmore, Bath	Geo. T. Ham, Conway.
Kaladar, Anglesea & Effingham Tp.	T. J. C. Tindle, Flinton	Moses Lessard, Flinton.
Newburgh V.		Chas. Wellbanks, Newburgh.
Napanee Tn.	G. H. Cowan, Napanee	W. A. Grange, Napanee.
Richmond Tp.	J. T. Vrooman, Napanee	J. McKittrick, Selby.
Sheffield Tp.	J. W. Wilson, Tamworth	Jas. Aylesworth, Tamworth.
Lincoln.		
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Caistor Tp.	Chas. Shupe, Attercliffe Station	A. Shields, Canfield.
Clinton Tp.	C. W. Elmore, Beamsville	G. W. Tinlin, Beamsville.
Gainsborough Tp.	W. Jamieson, Wellandport	S. W. Freure, Wellandport.
Grantham Tp.	W. H. Merritt, St. Catharines	L. S. Bessey, St. Catharines.
Grimsby N., Tp.	R. Alexander, Grimsby	T. W. Allan, Winona.
Grimsby S., Tp.	N. P. Henning, Smithville	F. W. Roberts, Smithville.
Grimsby V.	R. A. Alexander, Grimsby	Jas. Brodie, Grimsby.
Louth Tp.	A. H. Addy, Jordan	M. A. Ball, Jordan.
Merritton V.		
Niagara Tp.	C. E. Duggan, St. David's	John Knox, Virgil.
Port Dalhousie V.	E. T. Atkinson, Pt. Dalhousie	J. M. A. Waugh, Pt. Dalhousie.
St. Catharines City	F. King, St. Catharines	J. A. Pay, St. Catharines.
Niagara Tn.	J. F. Rigg, Niagara	W. E. Lyall, Niagara.
Manitoulin.		
Assiginack Tp.		
Billings Tp.		
Burpee Tp.	J. A. Baker, Gore Bay	Norman Bailey, Evansville.
Carnarvon Tp.		
Cockburn Island		D. J. McLeod, Cockburn Island.
Campbell Tn.		
Dawson		
Gordon Tp.	J. A. Baker, Gore Bay	John B. Gibson, Foxey.
Gore Bay Tn.	J. A. Baker, Gore Bay	W. T. Major, Gore Bay.
Howland Tp.	P. J. McDonald, Little Current	J. Bateman, Sheguiandah.
Killarney Tn.		
Little Current Tn.	P. J. McDonald, Little Current	D. McGilvery, Little Current.
Mills Tp.		
Robinson		
Sandfield Tp.	R. W. Davis, Mindemoya	T. W. Thompson, Big Lake.
Tehkummah	R. W. Shaw, Manitowaning	J. E. Hopkin, Tehkummah.
Middlesex.		
Adelaide Tp.	C. B. Eckel, Adelaide	Ambrose Topping, Kerwood.
Ailsa Craig V.	J. R. Anderson, Ailsa Craig	J. R. Anderson, Ailsa Craig.
Biddulph Tp.	C. A. Lang, Granton	W. D. Stanley, Granton.
Caradoc Tp.	Geo. Cairnes, Mt. Brydges	F. A. Cockwood, Mt. Brydges.
Delaware Tp.	F. H. Mitchell, Byron	J. H. Matthews, Delaware.
Dorchester N., Tp.	W. Doane, Harrietsville	W. B. Lane, Dorchester.
Ekfrid Tp.	R. D. Dewar, Melbourne	A. P. McDougald, Melbourne.
Glencoe V.		
Lobo Tp.	P. L. Graham, Lobo	E. R. Barclay, Poplar Hill.
London Tp.	D. G. McNeill, Arva	Mary Grant, 110 Dundas, London.
London City	T. V. Hutchinson, London	S. Baker, London.
Lucan V.	T. D. Orme, Lucan	G. A. Stanley, Lucan.
McGillivray Tp.	R. J. Hamilton, Ailsa Craig	J. D. Drummond, Ailsa Craig.
Metcalfe Tp.	C. W. Sawers, Napier	H. Thompson, Kerwood.

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Newbury V.	A. P. Ovens, Newbury	Chas. Tucker, Newbury.
Parkhill Tn.	Alex. Hotson, Parkhill	J. H. Laughton, Parkhill.
Strathroy Tn.	O. L. Berdan, Strathroy	F. W. Atkinson, Strathroy.
Westminster Tp.	G. A. Routledge, Lambeth	Geo. Riddell, Wilton Grove.
Williams E., Tp.	J. R. Anderson, Ailsa Craig	Wm. McCallum, Ailsa Craig.
Williams W., Tp.	D. C. Wilson, Parkhill	Wm. Dawson, Parkhill.
Wardsville V.	O. J. Glenn, Wardsville	Geo. O. Corneille, Wardsville.

Muskoka.

Brunel Tp.	C. C. Casselman, Huntsville	H. Farnsworth, Huntsville.
Bracebridge Tn.	J. H. Speers, Bracebridge	A. C. Salmon, Bracebridge.
Cardwell Tp.	S. A. Foote, Rosseau	M. Wilson, Rosseau.
Chaffey Tp.	J. W. Hart, Huntsville	J. H. Silverwood, Huntsville.
Draper Tp.	J. H. Speers, Bracebridge	D. Cairns, Uffington.
Freeman Tp.		T. A. Herbert, Foote's Bay.
Gravenhurst Tn.	J. A. C. Grant, Gravenhurst	W. H. Cross, Gravenhurst.
Huntsville Tn.	J. W. Hart, Huntsville	T. M. Cullon, Huntsville.
McLean & Ridout Tp.	P. B. McGibbon, Bracebridge	W. H. Brown, Baysville.
Macaulay Tp.	J. H. Speers, Bracebridge	Alex. Barron, Bracebridge.
Medora & Wood Tp.	A. M. Burgess, Bala	H. C. Guy, Dudley.
Monck Tp.	P. B. McGibbon, Bracebridge	H. F. Bickmore, Alport.
Morrison Tp.	A. McDermid, Severn Bridge	J. T. Bayley, Severn Bridge.
Muskoka Tp.	L. McLeay, Gravenhurst	Jas. Brydon, Gravenhurst.
Oakley Tp.	P. B. McGibbon, Bracebridge	Wm. Bone, Vankoughnet.
Port Carling V.	J. A. Rae, Port Carling	F. D. Stubbs, Port Carling.
Ryde Tp.	P. B. McGibbon, Bracebridge	W. Tingey, Gravenhurst.
Stephenson Tp.	J. H. Speers, Bracebridge	Daniel Bain, Utterson.
Stisted Tp.	J. W. Hart, Huntsville	Wm. H. Demaine, Etwell.
Watt Tp.	J. H. Speers, Bracebridge	Danl. Hamilton, Beatrice.

Nipissing.

Algonquin Park		
Bonfield Tn.	J. A. Bedard, North Bay	L. A. St. Cyr, Bonfield.
Evanturel Tp.		
Chisholm Tp.	A. S. Porter, Powassan	Edward Topps, Alderdale.
Caldwell Tp.	Paul O. Concombe, Verner	Ed. Beaudoin, Verner.
Calvin Tp.	J. D. Christie, Mattawa	D. Adams, Galston.
Cameron Tp.	M. James, Mattawa	
Casey Tp.		
Coleman Tp.	T. C. McLaren, Cobalt	P. J. Hart, Cobalt.
Cache Bay Tn.	F. W. McKee, Cache Bay	
Ferris Tp.	A. R. Dafoe, Callander	S. Moreau, Corbeil.
Cochrane Tn.	E. J. Vernon, Cochrane	H. J. Brown, Cochrane.
Gowganda Tn.		
Loyall & Sabin		
Martland Tp.		
Mattawa Tn.	M. James, Mattawa	Jno. McMeekin, Mattawa.
Mattawan Tp.	M. James, Mattawa	H. F. McMinn, Mattawa.
North Bay Tn.	Edgar Brandon, North Bay	Fred. Biggs, North Bay.
Papineau Tp.		
Springer Tp.	L. E. Bolster, Sturgeon Falls	O. Lafrance, Sturgeon Falls.
Sturgeon Falls Tn.	L. E. Bolster, Sturgeon Falls	J. D. Cockburn, Sturgeon Falls.
Temiskamingue Tn.		
Warren Tn.		
Widdifield Tp.	J. A. Bedard, North Bay	John A. Carmichael, North Bay.
Whitney Tn.		

Norfolk.

Charlotteville Tp.	W. J. McInnes, Vittoria	R. W. McCall, Vittoria.
Delhi V.	R. W. Tisdale, Delhi	Roger Crysler, Delhi.
Houghton Tp.	A. D. Naismith, Straffordville	W. V. Stevenson, Houghton.
Middleton Tp.	R. W. Tisdale, Delhi	D. W. White, Courtland.
Pt. Dover V.	J. F. Jolly, Port Dover	James Sloan, Port Dover.
Pt. Rowan V.		

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Waterford V.	W. R. Alway, Waterford	James Ross, Waterford.
Walsingham N., Tp.	T. Moffat Weir, Langton	Edgar Hodson, Langton.
Walsingham S., Tp.	W. A. Broddy, Port Rowan	W. M. Townsend, Walsingham Centre.
Windham Tp.	J. C. Bell, Teeterville	J. C. Camfield, Windham Centre.
Woodhouse Tp.	W. A. McKinnon, Port Dover	F. Bowlby, Simcoe.

NORTHUMBERLAND AND DURHAM.

Alnwick Tp.	F. A. Aylesworth, Roseneath	John McMillan, Roseneath.
Brighton Tp.	A. L. Webb, Brighton	Fred. O. Wade, Brighton.
Brighton V.	A. L. Webb, Brighton	A. Mark, Brighton.
Bowmanville Tn.	R. W. Clarke, Bowmanville	John Lyle, Bowmanville.
Cramahe Tp.	P. H. Huyck, Castleton	C. A. Wilson, Castleton.
Colborne V.	E. E. Latta, Colborne	George Keyes, Colborne.
Campbellford Tn.	R. H. Bonnycastle, Campbellford	A. J. Beavis, Campbellford.
Cobourg Tn.	G. H. Field, Cobourg	
Cartwright Tp.	A. D. McArthur, Blackstock	Wm. Beacock, Cæsarea.
Cavan Tp.	H. A. Turner, Millbrook	J. N. McGill, Millbrook.
Clarke Tp.	W. G. McCulloch, Orono	John Rickaby, Orono.
Darlington Tp.	C. W. Slemon, Enniskillen	W. R. Allin, Hampton.
Hamilton Tp.	Edgar Hayden, Cobourg	J. D. Stewart, Cobourg.
Hastings V.	T. B. Edmison, Hastings	A. Wilson, Hastings.
Hope Tp.	A. C. Beatty, Garden Hill	Thos. Roberts, Welcome.
Haldimand Tp.	J. C. Hutchison, Grafton	R. Lawless, Grafton.
Monaghan S., Tp.	A. L. Russell, Bailieboro	O. B. Johnson, S. Monaghan.
Murray Tp.	J. S. Anderson, Wooler	Wm. Little, Wooler.
Manvers Tp.	D. W. Clark, Pontypool	J. J. Preston, Bethany.
Millbrook V.	H. A. Turner, Millbrook	W. S. Given, Millbrook.
Newcastle V.	A. Farncomb, Newcastle	G. Jamieson, Newcastle.
Port Hope Tn.	G. A. Dickinson, Port Hope	J. W. Sanders, Port Hope.
Percy Tn.	C. C. Armstrong, Warkworth	P. S. Ewing, Warkworth.
Seymour Tp.	E. J. Free, Campbellford	J. B. Ferris, Campbellford.

ONTARIO.

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Brock Tp.	Jas. McDermott, Sunderland	Frank Doble, Sunderland.
Cannington V.	W. J. Henderson, Cannington	W. A. Robinson, Cannington.
Mara Tp.	Wm. Gilpin, Brechin	W. R. McPhee, Brechin.
Oshawa Tn.	T. W. G. McKay, Oshawa	Thos. Morris, Oshawa.
Pickering Tp.	N. C. McKinnon, Brougham	Donald R. Beaton, Whitevale.
Port Perry V.	D. Archer, Port Perry	
Rama Tp.	A. McDermid, Severn Bridge	W. M. Shields, O'Connell.
Reach Tp.	C. W. Henders, Saintfield	Wm. F. Dobson, Manchester.
Scugog Tp.	David Archer, Port Perry	Thos. Graham, Port Perry.
Scott Tp.	J. Henderson, Zephyr	Allan Gray, Uxbridge.
Thorah Tp.	Jas. Galloway, Beaverton	John McArthur, Beaverton.
Uxbridge Tp.	J. A. McClintock, Uxbridge	J. H. Mellard, Altona.
Uxbridge Tn.	J. A. McClintock, Uxbridge	M. H. Crosby, Uxbridge.
Whitby E., Tp.	D. S. Hoig, Oshawa	Wm. Purves, Columbus.
Whitby Tp.	Jas. Moore, Brooklin	D. Halliday, Brooklin.
Whitby Tn.	C. F. McGillivray, Whitby	Jos. White, Whitby.

OXFORD.

Blandford Tp.		
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Dereham Tp.	S. J. Morris, Mount Elgin	Alex. Bell, Mount Elgin.
Embro V.	H. Adams, Embro	E. J. Cody, Embro.
Ingersoll Tn.	J. W. Counter, Ingersoll	W. R. Smith, Ingersoll.
Nissouri E., Tp.	W. F. Babb, Thamesford	J. W. Sutherland, Lakeside.
Norwich N., Tp.	Jno. Johnston, Burgessville	Chas. E. Burgess, Burgessville
Norwich S., Tp.	A. J. Colver, Otterville	Alex. McFarlane, Otterville.

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Oxford N., Tp.	H. McGoughan, Thamesford	Rich. Seldon, Ingersoll.
Oxford W., Tp.	H. E. Arkell, Beachville	B. E. Jenvey, Ingersoll.
Tavistock V.	M. Steele, Tavistock	J. G. Field, Tavistock.
Tillsonburg Tn.	J. H. Hoover, Tillsonburg	A. E. Raynes, Tillsonburg.
Woodstock City	F. S. Ruttan, Woodstock	J. Morrison, Woodstock.
Zorra E., Tp.	A. U. Hotson, Innerkip	Jas. Anderson, Woodstock.
Zorra W., Tp.	Henry Adams, Embro	Allan Murray, Embro.

Parry Sound.

Armour Tp.	H. L. Barber, Burk's Falls	F. Metcalfe, Burk's Falls.
Burk's Falls V.	H. L. Barber, Burk's Falls	C. McArthur, Burk's Falls.
Carling Tp.	S. B. Biehn, Parry Sound	J. D. Broughton, Parry Sound.
Chapman Tp.	J. S. Freeborn, Magnetawan	H. Q. Snuggs, Magnetawan.
Christie Tp.	G. F. Richardson, Sprucedale	Wells Thompson, Orrville.
Foley Tp.	S. B. Biehn, Parry Sound	And. Oastler, James Bay Junc.
Hagerman Tp.	J. S. Freeborn, Magnetawan	F. N. Macfie, Dunchurch.
Himsworth N., Tp.	A. R. Dafoe, Callander	John R. Moon, Callander.
Himsworth S., Tp.	R. H. Dillane, Powassan	Robert Ferguson, Powassan.
Humphrey Tp.	S. A. Foote, Rosseau	A. A. Young, Rosseau.
Joly Tp.	H. B. Andrews, Sundridge	Geo. Harkness, Sundridge.
Kearney Tn.	W. E. Mason, Kearney	J. J. Brosnan, Kearney.
McDougall Tp.		
McKellar Tp.	M. H. Limbert, Parry Sound	John Fletcher, McKellar.
McMurrich Tp.	G. F. R. Richardson, Sprucedale	D. C. McFarlane, Sprucedale.
Machar Tp.	R. J. McComb, South River	Andrew McKee, Stewart Bay.
Nipissing Tp.	R. H. Dillane, Powassan	W. S. Rowson, Nipissing.
Parry Sound Tn.	M. H. Limbert, Parry Sound	E. E. Armstrong, Parry Sound.
Perry Tp.		
Powassan Tn.	A. S. Porter, Powassan	L. G. Phillips, Powassan.
Ryerson Tp.	A. W. Partridge, Burk's Falls	F. Metcalfe, Burk's Falls.
Strong Tp.	A. W. Partridge, Burk's Falls	A. M. Church, Sundridge.
South River V.	R. J. McComb, South River	H. B. Naismith, South River.
Sundridge V.	H. B. Andrew, Sundridge	John Harper, Sundridge.
Wilson Tp.		
Trout Creek Tn.	R. H. Dillane, Powassan	B. E. Green, Trout Creek.

Peel.

Albion Tp.	T. W. Allison, Caledon East	Robt. Matson, Palgrave.
Bolton V.	W. R. Bateman, Bolton	John McDonald, Bolton.
Brampton Tn.	W. D. Sharpe, Brampton	W. H. McFadden, Brampton.
Caledon Tp.	G. K. McKinnon, Alton	L. H. Willis, Belfountain.
Chinguacousy Tp.	A. R. Burns, Claude	Robt. Kee, Cheltenham.
Streetsville V.	J. R. Glendinning Streetsville	S. H. Smith.
Toronto Tp.		C. H. Gill, Dixie.
Toronto Gore Tp.	P. D. McLean, Woodbridge	N. Harrison, Castlemore.

Perth.

Blanshard Tp.	C. A. Campbell, Kirkton	Jno. H. Jameson, Rannoch.
Downie Tp.	A. Nichol, Sebringville	P. Smith, Stratford.
Easthope N., Tp.	George Ford, Shakespeare	J. D. Fisher, Amulree.
Easthope S., Tp.	E. Trow, Shakespeare	V. Stock, Tavistock.
Ellice Tp.	F. Parker, Stratford	Justus Kreuter, Rostock.
Elma Tp.	D. A. Kidd, Atwood	Geo. Lockhead, Atwood.
Fullarton Tp.	John Proudfoot, Fullarton	R. H. Pomeroy, Fullarton.
Hibbert Tp.	A. V. H. Michell, Dublin	James Jordan, Dublin.
Logan Tp.	A. D. Smith, Mitchell	Marvin Leake, Mitchell.
Listowel Tn.	L. W. Thompson, Listowel	Wm. Bright, Listowel.
Mornington Tp.	W. C. Pratt, Millbank	Wm. Waddell, Burns.
Milverton V.	P. L. Tye, Milverton	W. D. Weir, Milverton.
Mitchell Tn.	W. J. Armstrong, Mitchell	Wm. Ryan, Mitchell.
Stratford City	J. A. Robertson, Stratford	Robt. R. Lang, Stratford.
Wallace Tp.	L. W. Thompson, Listowel	David Greer, Gowanstown.
St. Mary's Tn.	A. E. Fraleigh, St. Mary's	T. M. Clark, St. Mary's.

PETERBORO.	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Asphodel Tp.		
Belmont & Methuen	H. C. Kindred, Havelock	W. H. Johnson, Havelock.
Burleigh & Anstruther	L. E. Shepard, Apsley	W. Gallon, Apsley.
Chandos Tp.		L. P. Bullied, Lasswade.
Douro Tp.	J. R. Fraser, Lakefield	F. D. Leahy, Lakefield.
Dummer Tp.	Donald Munro, Warsaw	Rich. Deen, Warsaw.
Ennismore Tp.	J. McNulty, Peterboro	Jno. Maloney, Ennismore.
Galway & Cavendish	E. A. White, Kinmount	Patrick Collins, Mount Irwin.
Harvey Tp.	H. O. Boyd, Bobcaygeon	David Weir, Peterboro.
Havelock V.	J. Holdcroft, Havelock	Edward Fennell, Havelock.
Lakefield V.	M. R. Graham, Lakefield	W. Sherin, Lakefield.
Monaghan N., Tp.	T. N. Greer, Peterboro	Bruce Johnston, Peterboro.
Norwood V.	N. F. Sutton, Norwood	E. J. Laing, Norwood.
Otonabee Tp.	C. F. Ross, Keene	J. M. Drummond, Peterboro.
Peterboro City	A. W. McPherson, Peterboro	S. R. Armstrong, Peterboro.
Smith Tp.	J. A. Morgan, Peterboro	J. W. Kelly, Bridgenorth.

PRESCOTT AND RUSSELL.

Alfred Tp.	Ulric Gaboury, Plantagenet	B. G. Parisien, Alfred.
Caledonia Tp.	J. M. Ravary, St. Isidore de Prescott	R. L. Downing, Routhier.
Cambridge Tp.	J. P. Boyle, Casselman	J. Bte. Sanche, Casselman.
Clarence Tp.	A. Bourque, Bourget	J. A. Menard, Bourget.
Cumberland Tp.	J. C. Greenleese, Vars	W. W. Dunning, Cumberland.
Casselman V.		
Hawkesbury W., Tp.	D. J. McIntosh, Vankleek Hill	W. J. Dunning, Vankleek Hill.
Hawkesbury E., Tp.	A. Labrosse, St. Eugene	Nap. Labrosse, St. Eugene.
Hawkesbury Tn.	R. P. Pattee, Hawkesbury	Eug. Paquette, Hawkesbury.
Longueil Tp.		
L'Orignal V.		
Plantagenet N., Tp.	U. Gaboury, Plantagenet	D. M. Viau, Wendover.
Plantagenet S., Tp.	J. A. Charlebois, Fournier	W. N. Dunning, Riceville.
Russell Tp.	D. S. McDougall, Russell	W. R. Craig, Russell.
Rockland Tn.	M. Powers, Rockland	Jas. Lagrois, Rockland.
Vankleek Hill Tn.	D. G. McIntosh, Vankleek Hill	W. J. Dunning, Vankleek Hill.

PRINCE EDWARD.

Ameliasburg Tp.	A. J. File, Ameliasburg	F. C. File, Ameliasburg.
Athol Tp.	C. A. Publow, Picton	W. Moore, Picton.
Bloomfield V.	F. Cahoon, Bloomfield	C. H. Taylor, Bloomfield.
Hallowell Tp.	F. Cahoon, Bloomfield	E. B. Yarwood, Picton.
Hillier Tp.	F. B. Thornton, Consecon	Percy Wilson, Hillier.
Marysburg N.	Morley Currie, Picton	Levi Williams, Picton.
Marysburg S.	M. Currie, Picton	Harvey Grimmon, Milford.
Picton Tn.	Chas. A. Publow, Picton	P. C. McNee, Picton.
Sophiasburg Tp.	John Cryan, Demorestville	C. H. Wright, Demorestville.
Wellington V.	J. B. Ruttan, Wellington	E. A. Titus, Wellington.

RAINY RIVER.

Alberton Tp.	D. C. McKenzie, Fort Frances	F. H. Warner, Fort Frances.
Atwood & Curran Tp.		
Chapple Tp.	F. H. Bethune, Emo	J. A. McNabb, Barwick.
Dilke Tp.	R. M. Charlton, Rainy River	A. A. Snider, Pinewood.
Emo Tp.	F. H. Bethune, Emo	D. Strachan, Emo.
Eaton Tn.		
Fort Frances Tn.	H. W. Johnson, Fort Frances	J. W. Walker, Fort Frances.
Ignace Tp.	C. R. Bunn, Ignace	Wm. Earles, Ignace.
Lac Seul Tn.		
Lavallee Tp.	F. H. Bethune, Emo	Arthur Cooke, Devlin.
Mine Centre Tn.		
Morley Tp.	R. M. Charlton, Rainy River	Guy G. Gamsby, Stratton.
McIrvine Tp.	H. W. Johnson, Fort Frances	Frank J. Strain, Fort Frances.
Rainy River Tn.	D. McBane, Rainy River	E. E. Jess Rainy River.

Rainy River.—*Cont'd.*	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Worthington & Blue Tp.		
Wells, Sutherland & McCrossin Tp.		
Wainwright Tn.		
Oxdrift Tn.		

RENFREW.

Arnprior Tn.	J. G. Cranston, Arnprior	T. H. Grout, Arnprior.
Admaston Tp.	Dr. McCormack, Renfrew	R. W. Brown, Admaston Statn.
Algona, S., Tp.	J. Reeves, Eganville Dr. McDermott, Killaloe Station.	J. P. Neelin, Castile.
Alice & Fraser	F. C. Delahey, Pembroke	J. M. Kennedy, Pembroke.
Bagot & Blythfield	J. O'Reilly, Calabogie	J. J. Dillon, Calabogie.
Bromley Tp.	R. H. Carscadden, Douglas	Jas. D. Walsh, Cobden.
Brougham Tp.	J. O'Reilly, Calabogie	Michael Sheedy, Mt. St. Patrick.
Brudenell & Lynedoch	J. P. McDermott, Killaloe Stn.	T. L. O'Grady, Brudenell.
Cobden V.	Ira D. Cotnam, Cobden	Jos. R. Warren, Cobden.
Eganville V.	M. J. Maloney, Eganville	John George, Eganville.
Grattan Tp.	M. J. Maloney, Eganville	John George, Eganville.
Griffith & Matawatchan	Dr. Adams, Denbigh	Austin Legree, Khartum.
Hagarty & Richards	J. P. McDermott, Killaloe Stn.	Peter Lavelle, Rochefort.
Head, Clara, Maria		
Horton Tp.	James Mann, Renfrew	E. J. Stewart, Renfrew.
McNab Tp.	J. J. McCann, Renfrew	John McGregor, Renfrew.
Pembroke Tp.	F. C. Delahey, Pembroke	H. W. Perrett, Pembroke.
Pembroke Tn.	A. J. Sparling, Pembroke	A. J. Fortier, Pembroke.
Petewawa Tp.	F. C. Delahey, Pembroke	F. Geisebrecht, Petewawa.
Renfrew Tn.	J. J. McCann, Renfrew	J. A. Devenny, Renfrew.
Radcliffe Tp.	J. L. Poirier, Craigmont	J. E. H. Miller, Combermere.
Raglan Tp.	J. L. Poirier, Craigmont	C. F. Schmelzle, Jewelville.
Rolph, B., & Wylie	F. J. Dodd, Pembroke	Miss F. McCarthy, Wylie.
Ross Tp.	Jonathan Brown, Foresters' Falls	P. R. Pounder, Forester's Falls.
Sebastopol Tp.	Jas. Reeves, Eganville	Carl Walther, Vanbrugh.
Sherwood, Jones & Burns	John Evans, Barry's Bay	S. E. Smith Barry's Bay.
Stafford Tp.	F. C. Delahey, Pembroke	John Kidd, Cobden.
Westmeath Tp.	Geo. Forbes, Beachburg	Hugh S. Miller, Beachburg.
Wilberforce & Algona, N.	Jas. Reeves, Eganville	T. McKibbon, Eganville.

SIMCOE.

Adjala Tp.	J. Campbell, Tottenham	G. H. Watson, Athlone.
Alliston Tn.	J. J. Harper, Alliston	Wm. Lockhart, Alliston.
Beeton V.	R. S. Brewster, Beeton	Jos. Wright, Beeton.
Bradford V.	F. C. Stevenson, Bradford	R. E. Stevenson, Bradford.
Barrie Tn.	A. T. Little, Barrie	E. Donnell, Barrie.
Coldwater V.	J. A. Harvie, Coldwater	Howard Chester, Coldwater.
Creemore V.	J. L. Bradley, Creemore	A. H. Watson, Creemore.
Collingwood Tn.	Donald McKay, Collingwood	J. H. Duncan, Collingwood.
Essa Tp.	S. West, Angus	J. Coxworth, Ivy.
Flos Tp.	J. B. McClinton, Elmvale	C. H. Burton, Elmvale.
Gwillimbury W., Tp.	J. A. Cummings, Bond Head	E. J. Evans, Bradford.
Innisfil Tp.	N. W. Rogers, Stroud	R. M. McConkey, Nantyr.
Matchedash Tp.		E. W. Kitchen, Lovering.
Medonte Tp.	W. F. Adams, Hillsdale	T. D. Robinson, Moonstone.
Midland Tn.	F. C. Macdonald, Midland	Frank R. Weston, Midland.
Nottawasaga Tp.	L. McAlister, Duntroon	L. McAlister, Duntroon.
Orillia Tp.	John McLean, Orillia	John C. Rose, Orillia.
Oro Tp.	Geo. B. Jamieson, Edgar	H. J. Tudhope, Hawkestone.
Orillia Tn.	John McLean, Orillia	Jas. B. Henderson, Orillia.
Penetanguishene Tn.	P. H. Spohn, Penetanguishene	W. H. Hewson, Pentanguishene.
Sunnidale Tp.	W. D. Smith, Creemore	Thos. F. Burrows, Stayner.
Stayner Tp.	R. R. Smale, Stayner	John Hood, Stayner.
Tecumseth Tp.	R. S. Brewster, Beeton	Wm. Lilly, Beeton.

SIMCOE.—*Continued.*	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Tiny Tp.	Geo. Bowman, Penetanguishene	M. Beaudoin, Lafontaine.
Tossorontio Tp.	B. N. Macaulay, Everett	Thos. Irwin, Lisle.
Tottenham V.	Jas. Campbell, Tottenham	S. H. Nolan, Tottenham.
Tay Tp.	W. E. Brown, Victoria Harbor	T. W. Brown, Victoria Harbor.
Vespra Tp.	V. A. Hart, Barrie	A. B. Coutts, Barrie.
Victoria Harbor V.	W. E. Brown, Victoria Harbor	E. B. Brown, Victoria Harbor.

STORMONT, DUNDAS AND GLENGARRY.

Alexandria Tn.	Kenneth McLennan, Alexandria	Saml. Macdonnell, Alexandria.
Cornwall Tp.	J. W. Messecar, Mille Roches	John Mullin, Mille Roches.
Cornwall Tn.	C. J. Hamilton, Cornwall	J. G. Harkness, Cornwall.
Chesterville V.	W. A. Brown, Chesterville	Geo. Elliot, Chesterville.
Charlottenburg Tp.	E. J. Robinson, Williamstown	Geo. A. Watson, Williamstown.
Finch V.	E. H. Marcellus, Finch	J. W. Carr, Finch.
Finch Tp.	W. E. Crain, Crysler	D. B. Cameron, Berwick.
Iroquois V.		
Kenyon Tp.	A. D. McMillan, Apple Hill	J. D. Cameron, Greenfield.
Lancaster Tp.	J. Y. Baker, Dalhousie Mills	A. J. Macdonald, N. Lancaster.
Lancaster V.	A. D. Faulkner, Lancaster	J. Webb, Lancaster.
Lochiel Tp.	A. T. Munroe, Dalkeith	V. G. Chisholm, Lochiel.
Matilda Tp.	J. Harkness, Irena	J. J. Payne, Brinston.
Mountain Tp.	S. E. Porter, South Mountain	Jno. E. Crowder, Inkerman.
Maxville V.	W. B. McDiarmid, Maxville	D. P. McDiarmid, Maxville.
Morrisburg V.	E. McLaughlin, Morrisburg	T. R. Chalmers, Morrisburg.
Osnabruck Tp.	J. S. Dickey, Newington	H. E. Hodgins, Farran's Point.
Roxborough Tp.	W. B. McDiarmid, Maxville	F. D. Brunch, Moose Creek.
Williamsburg Tp.	M. W. Locke, Williamsburg	Geo. Lane, Williamsburg.
Winchester Tp.	P. McLaughlin, Winchester	Geo. Elliot, Chesterville.
Winchester V.	P. McLaughlin, Winchester	W. J. Laflamme, Winchester.

SUDBURY DISTRICT.

Balfour Tp.	J. E. Charbonneau, Chelmsford	J. A. Bastien, Chelmsford.
Baldwin Tp.		
Blezard Tp.	J. E. Charbonneau, Chelmsford	G. Bonin, Blezard Valley.
Chapleau V.	J. J. Sheahan, Chapleau	J. T. Smart, Chapleau.
Chelmsford Tn.		
Copper Cliff Tn.	W. A. McAuley, Copper Cliff	Thos. Stoddart, Copper Cliff.
Casimir, Jennings & Appleby Tp.	J. O. Dutrizac, St. Charles	J. Levert, St. Charles.
Drury, Denison & Graham	T. S. Kirby, Crean Hill	F. E. Loney, Worthington.
Hagar Tp.		J. Brown, Markstay.
Hallam Tp.	W. H. Dudley, Webbwood	Jas. H. Toland, Webbwood.
Hanmer Tp.		
Martland Tp.		
McKim Tp.	W. H. Dixon, Sudbury	J. R. Vincent, Sudbury.
Massey Tn.		
Nairn Tp.	W. H. Dudley, Webbwood	Herbert Edwards, Nairn Centre.
Neelon & Garson		
Ratter & Dunnett	J. A. Kearns, Warren	Emile Langlois, Warren.
Rayside	J. E. Charbonneau, Chelmsford	Ed. Joliat, Boninville.
Salter, May & Harrow	T. F. Flaherty, Massey	Oscar Cole, Massey.
Sudbury Tn.	W. J. Cook, Sudbury	W. J. Ross, Sudbury.
Snider Tp.		
Waters	J. H. Bennett, Copper Cliff	P. G. Gandrault, Copper Cliff.
Webbwood Tn.	W. H. Dudley, Webbwood	Thos. Brinsmead, Webbwood.

TEMISKAMING DISTRICT.

Bucke Tp.	J. A. Creasor, North Cobalt	Herbert A. Day, Haileybury.
Cobalt Tn.	T. C. McLaren, Cobalt	R. L. O'Gorman, Cobalt.
Haileybury Tn.	G. F. Jackson, Haileybury	Theo. H. Connor, Haileybury.
Tisdale Tp.	H. M. McNeill, South Porcupine	W. H. Wilson, South Porcupine.
Dack Tp.	Geo. Cooper, Charlton	J. K. Dugan, Charlton.
Dymond Tp.	A. J. Fisher, New Liskeard	E. F. Stephenson, New Liskeard.

TEMISKAMING.—*Con't.*	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Englehart Tn.	R. C. Lowery, Englehart	J. Hampden Field, Englehart.
Harris Tp.	J. D. McNaughton, New Liskeard	Fred. Wilson, New Liskeard.
Harley Tp.	J. D. McNaughton, New Liskeard	Edgar Cragg, Hanbury.
Hilliard Tp.	R. C. Lowrey, Englehart	C. Wood, Hilliardston.
Hudson Tp.	J. D. McNaughton, New Liskeard	E. Sackrider, New Liskeard.
James Tp.	J. F. McKee, Elk Lake	D. W. Podis, Elk Lake.
Kerns Tp.	J. D. McNaughton, New Liskeard	H. M. Ship, Milberta.
Latchford Tn.	T. C. McLaren, Cobalt	S. A. Starling, Latchford.
Matheson Tn.	J. P. Wilson, Swastika	E. B. Sanders, Matheson.
New Liskeard Tn.	A. J. Fisher, New Liskeard	J. I. Dixon, New Liskeard.
THUNDER BAY.		
Fort William City	E. B. Oliver, Fort William	A. McNaughton, Fort William.
Nepigon Tp.		
Neebing Tp.		
O'Connor Tp.	D. L. McKenna, Hymers	C. J. Evans, O'Connor.
Oliver Tp.	R. A. Caldwell, Port Arthur	C. R. B. Hill, Murillo.
Paipoonge Tp.		
Port Arthur City	C. N. Laurie, Port Arthur	T. F. Milne, Port Arthur.
Schreiber Tp.	H. S. Crowe, Schreiber	Geo. A. Evans, Schreiber.
Shuniah Tp.		
Conmee V.	R. A. Caldwell, Port Arthur	R. Pifer, Kakabeka Falls.
VICTORIA.		
Bexley Tp.	E. W. Huxtable, Victoria Road	Alfred Taylor, Victoria Road.
Bobcaygeon V.	S. Thorne, Bobcaygeon	Chas. E. Stewart, Bobcaygeon.
Carden Tp.	J. F. Ross, Kirkfield	John Walsh, Kirkfield.
Dalton Tp.	J. F. Ross, Kirkfield	B. Nicholson, Sebright.
Eldon Tp.	J. F. Ross, Kirkfield	B. Stacey, Lorneville.
Emily Tp.	Geo. N. Earle, Omemee	R. J. Grandy, Omemee.
Fenelon Tp.	John W. Ray, Cambray	John B. Powles, Powles' Corner.
Fenelon Falls V.	V. H. B. Johnstone, Fenelon Falls	E. Fitzgerald, Fenelon Falls.
Laxton, etc., Tp.	J. B. Auston, Coboconk	E. F. Le Craw, Norland.
Lindsay Tn.	John McAlpine, Lindsay	D. Ray, Lindsay.
Mariposa Tp.	G. W. Hall, Little Britain	J. B. Weldon, Oakwood.
Ops Tp.	F. Blanchard, Lindsay	W. E. Agnew, Lindsay.
Omemee V.	J. N. Thompson. Omemee	W. H. Kennedy, Omemee.
Sturgeon Point V.	W. G. Collison, Lindsay	G. H. Hopkins, Lindsay.
Somerville Tp.	E. A. White, Kinmount	A. B. Townsend, Burnt River.
Verulam Tp.	H. O. Boyd, Bobcaygeon	Geo. W. Taylor, Bobcaygeon.
Woodville V.	John Grant, Woodville	A. E. Staback, Woodville.
WATERLOO.		
Ayr V.	N. W. Meldrum, Ayr	A. J. Reid, Ayr.
Berlin C.	Jno. McGillawee, Berlin	A. H. Millar, Berlin.
Dumfries N., Tp.	Adam Thomson, Galt	Jos. Wrigley, Ayr.
Elmira V.	R. W. Faulds, Elmira	J. H. Ruppel, Elmira.
Galt Tn.	Thos. W. Vardon, Galt	Jos. McCartney, Galt.
Hespeler Tn.	A. H. Campbell, Hespeler	M. E. Jardine, Hespeler.
New Hamburg V.	John Marty, New Hamburg	J. F. Katzenmeier, New Hamburg.
Preston Tn.	J. Scott Hogg, Preston	H. C. Edgar, Preston.
Waterloo N., Tp.	A. Thomson, Galt	G. A. Tilt, Blair.
Wellesley Tp.	D. McEachern, Linwood	P. F. Schummer, St. Clements.
Wilmot Tp.	W. Gillespie, Baden	F. Holwell, Baden.
Woolwich Tp.	J. M. Nairn, Winterbourne	W. J. Snider, Conestogo.
Waterloo Tn.	A. F. Baumann, Waterloo	Jas. C. Haight, Waterloo.
WELLAND.		
Bertie Tp.	N. Brewster, Ridgeway	M. S. Pound, Ridgeway.
Bridgeburg V.	A. Collins, Bridgeburg	R. A. Land, Bridgeburg.
Crowland Tp.	J. H. Howell, Welland	H. L. Pratt, Welland.
Chippewa V.	A. Gray, Chippewa	C. Weinbrenner, Chippewa.

WELLAND.—*Continued.*	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Fort Erie V.	Wm. Douglass, Fort Erie	Wm. Simmons, Fort Erie.
Humberstone Tp.	A. V. Laing, Humberstone	A. E. Near, Gas Line.
Humberstone V.	A. V. Laing, Humberstone	J. J. Wichmann, Humberstone.
Pelham Tp.	H. L. Emmett, Fonthill	A. M. Armbrust, Ridgeville.
Pt. Colborne V.	John Shultis, Port Colborne	
Stamford Tp.	H. Logan, Niagara Falls South	C. F. Monroe, South End.
Thorold Tn.	Neil Campbell, Thorold	D. J. C. Munro, Thorold.
Thorold Tp.	H. Park, Port Robinson	John A. Clark, Fonthill.
Wainfleet Tp.	J. M. Park, Marshville	Jos. Henderson, Jr., Marshville.
Willoughby Tp.	J. B. Buell, Stevensville	J. A. Plyley, Chippewa.
Welland Tn.	J. H. Howell, Welland	C. M. Webber, Welland.
Niagara Falls City	H. Logan, Niagara Falls	W. J. Seymour, Niagara Falls.

WELLINGTON.

Arthur Tp.	A. J. Reynolds, Mount Forest	Albert Hillyer, Kenilworth.
Arthur V.	E. Allan, Arthur	D. T. Small, Arthur.
Eramosa Tp.	E. F. McCullough, Rockwood	W. M. Head, Guelph.
Erin Tp.	A. Gibson, Hillsburg	Peter McLaren, Hillsburg.
Elora V.	W. Robertson, Elora	Henry Clarke, Elora.
Erin V.	Henry Gear, Erin	Wm. Conboy, Erin.
Fergus V.	H. W. Armstrong, Fergus	Jas. Beattie, Fergus.
Garafraxa W., Tp.	W. J. M. Marcy, Belwood	Jas. Campbell, Belwood.
Guelph Tp.	G. Roberts, Guelph	Jas. Laidlaw, Guelph.
Harriston Tn.	S. M. Henry, Harriston	A. J. Stewart, Harriston.
Luther W., Tp.	J. G. Bricker, Conn	W. W. Duncan, Conn.
Clifford V.	Geo. Harrison, Clifford	J. A. Aitchison, Clifford.
Drayton V.	E. Flath, Drayton	A. C. Woodman, Drayton.
Guelph City	H. O. Howitt, Guelph	T. J. Moore, Guelph.
Maryborough Tp.	A. C. Munns, Moorefield	W. W. Scott, Moorefield.
Minto Tp.	H. R. McCullough, Harriston	W. D. McLellan, Harriston.
Mount Forest Tn.	A. R. Perry, Mount Forest	W. C. Perry, Mount Forest.
Nichol Tp.	W. A. Kerr, Elora	J. R. Wissler, Salem.
Peel Tp.	J. P. McKinnon, Glen Allen, and Dr. Quibber, Alma	Edward Gainer, Arthur.
Pilkington Tp.	W. Robertson, Elora	Geo. F. Cromar, Elora.
Puslinch Tp.	Jas. H. King, Morriston	A. B. Falconbridge, Aberfoyle.
Palmerston V.		

WENTWORTH.

Ancaster Tp.	G. D. Farmer, Ancaster	H. Pim, Ancaster.
Barton Tp.	E. A. Alway, Bartonville	A. G. Bryant, Mt. Hamilton.
Beverly Tp.	J. L. Gibson, Lynden	Wm. Wood, Rockton
Binbrook Tp.	Geo. W. Houston, Binbrook	
Dundas Tn.	T. A. Bertram, Dundas	John S. Fry, Dundas.
Flamboro E., Tp.	D. A. Hopper, Waterdown	Geo. Church, Waterdown.
Flamboro W., Tp.	Jas. McQueen, Freelton	Ira N. Binkley, Greensville.
Glanford Tp.	E. T. Boyes, Mount Hope	Daniel Reed, Mount Hope.
Hamilton City	Jas. Roberts, Hamilton	S. H. Kent, Hamilton.
Saltfleet Tp.	F. T. Green, Stoney Creek	Erland Lee, Stoney Creek.
Waterdown V.	D. A. Hopper, Waterdown	J. C. Medlar, Waterdown.

YORK.

Aurora Tn.	W. J. Stevenson, Aurora	S. H. Lundy, Aurora.
Etobicoke Tp.	E. Bull, Lambton Mills	S. Barratt, Islington.
Georgina Tp.	W. J. Boynton, Pefferlaw	Donald Ego, Virginia.
Gwillimbury N., Tp.	H. H. Pringle, Sutton West	F. L. VanNorman, Keswick.
Holland Landing V.	L. H. Campbell, Bradford	F. J. Sheppard, Holland Landing.
King Tp.	G. D. Lockhart, King City	J. L. Jenkins, King City.
Markham Tp.	Chas. McKay, Unionville	C. H. Stiver, Unionville.
Markham V.	T. A. Young, Markham	M. White, Markham.
Newmarket Tn.	Stuart Scott, Newmarket	J. E. Hughes, Newmarket.
New Toronto V.	J. R. Serson, Mimico	Geo. D. Scott, New Toronto.
Richmond Hill V.	W. R. Pentland, Richmond Hill	A. J. Hume, Richmond Hill.

YORK.—*Continued.*	M. O. H. and P.O. Address.	Secretary and P.O. Address.
Scarborough Tp.	E. N. Coutts, Agincourt	Thos. Crawford, Agincourt.
Stouffville V.	F. A. Dales, Stouffville	J. Urquhart, Stouffville.
Sutton V.	C. T. Noble, Jr., Sutton West	T. G. Tremayne, Sutton West.
Toronto City	C. J. Hastings, City Hall	W. A. Littlejohn, City Hall.
Vaughan Tp.	T. H. Robinson, Kleinburg	J. B. McLean, Maple.
Whitechurch Tp.	S. L. Freel, Stouffville	W. H. Clarke, Stouffville.
Weston V.	J. A. Meldrum, Weston	J. H. Taylor, Weston.
Woodbridge V.	P. D. McLean, Woodbridge	Ed. W. Brown, Woodbridge.
York Tp.	C. A. Warren, 536 St. Clair Ave. W., Toronto	W. A. Clarke, 40 Jarvis Street, Toronto.
Gwillimbury E., Tp.	E. D. Graham, Queensville	A. R. McKenzie, Queensville.
Mimico V.	Carmen Ricker, Mimico	J. A. Telfer, Mimico.

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Report